

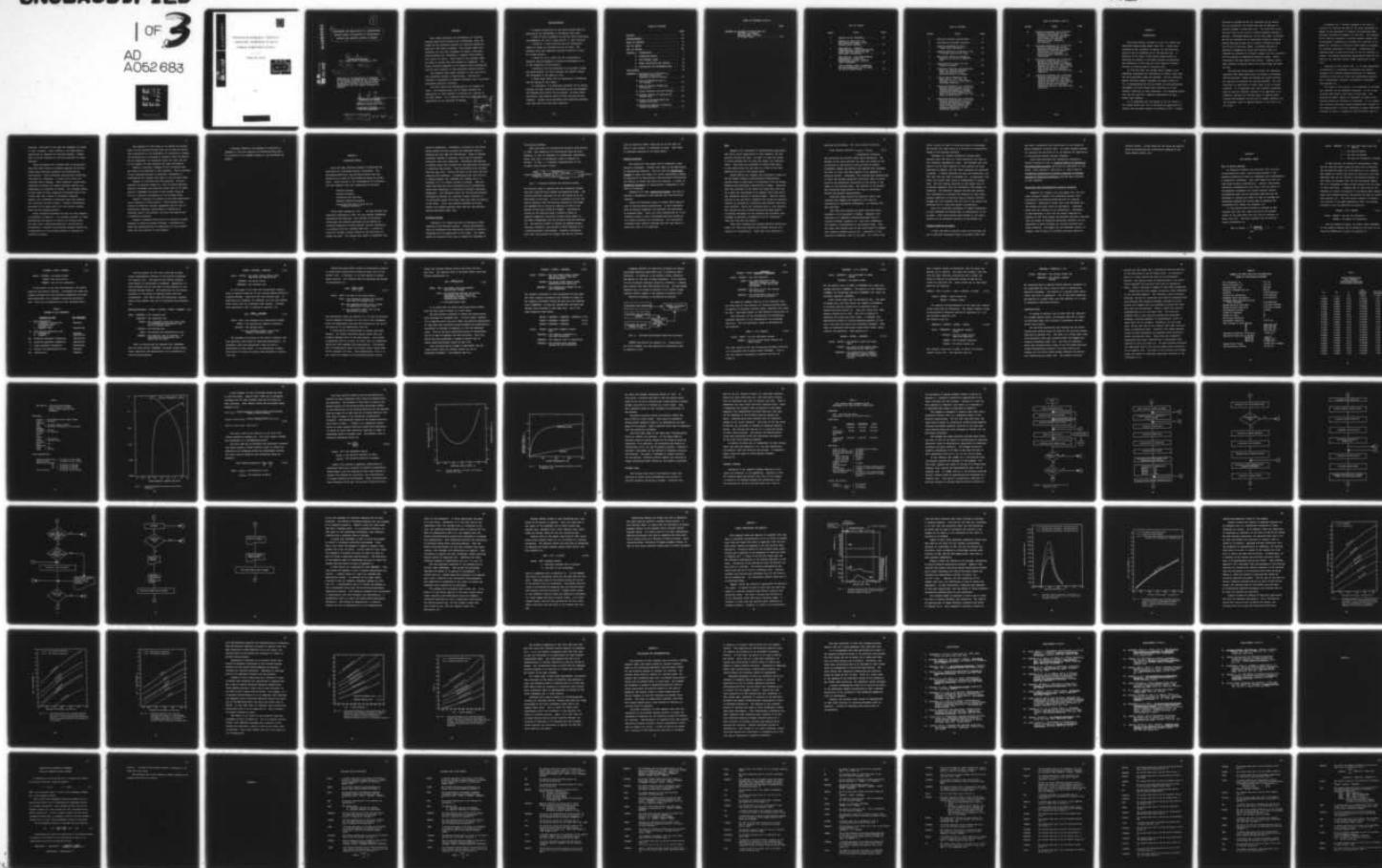
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KANSAS UNIV LAWRENCE DEPT OF CHEMICAL AND PETROLEUM--ETC F/G 8/9
DEVELOPMENT AND APPLICATION OF A COMPUTERIZED ECONOMIC MODEL FO--ETC(U)
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DEVELOPMENT AND APPLICATION OF A COMPUTERIZED
ECONOMIC MODEL FOR ANALYSIS OF THE MICETAR
TERTIARY OIL RECOVERY PROCESS IN KANSAS

GEORGE NEAL PLOCK

1976

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DEVELOPMENT AND APPLICATION OF A COMPUTERIZED
ECONOMIC MODEL FOR ANALYSIS OF THE MICELLAR
TERTIARY OIL RECOVERY PROCESS IN KANSAS.

①

⑩

by

George Neal Plocek

B.S., Texas A and I University, 1962

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1976

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204p.

⑨

Master's thesis,

Submitted to the Department of Chemical
and Petroleum Engineering and the Faculty
of the Graduate School of the University
of Kansas in partial fulfillment of the
requirements for the degree of master of
science.

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APR 4 1976
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ABSTRACT

This thesis describes the development of a digital computer model which analyzes the investments, costs and income for the micellar tertiary oil recovery process as applied in the state of Kansas. The economic model will calculate the oil price necessary to attain a specified rate-of-return and, conversely, a present worth profile for a given oil price. Input data for the economic model are based on actual data from Kansas oil operators. The output includes summaries of the present worth calculations and oil price required to make specified rates-of-return.

The economic model makes available to the user one of four different methods of depreciation. Options are included to capitalize or expense chemicals, and to calculate percentage depletion allowance.

The test results are representative of a Kansas oil field. The economic model can be easily modified for application to other methods of tertiary oil recovery or to other states. It is expected that this model will find application by oil operators in Kansas.

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CHAPTER 1

INTRODUCTION

The United States' economy is built on a stable and relatively cheap energy supply base (16). Fossil fuel consumption has increased in demand, but the discovery rates of the oil industry are on the decline (11). A majority of oil found in the United States cannot be recovered by primary or secondary methods of production and therefore, in the long run, more advanced tertiary methods of recovery must be utilized (28).

In 1973 and 1974, the energy crisis brought a new awakening concerning the availability of fossil fuels that had been previously taken for granted. The Oil Producing Export Countries (OPEC) increased the export prices of oil to approximately \$11.00 per barrel (9) and governments throughout the world became most concerned as to the economic stability of their countries. Oil producing states also saw the need for a greater conservation of their fossil fuel reserves.

It is estimated that two-thirds of the oil found in the United States will not be recovered by application of primary and secondary methods of production (28). Primary

recovery is defined as the oil recovered by any natural flow or artificial lift method that may be employed to produce through a single well bore. The fluid must enter the well bore by the action of native reservoir energy or gravity. Secondary recovery, on the other hand, is defined as the oil recovered by an artificial flowing or pumping method that may be employed to produce through the joint use of two or more well bores. Secondary recovery is generally recognized as being that recovery which is obtained by injection of liquids or gases into the reservoir for the purpose of augmenting reservoir energy. Water-flooding is the most widely used method. Usually, secondary recovery is applied after the primary phase has passed (20).

New ways are being sought to recover the remaining resources left after application of primary or secondary recovery methods. These new methods are termed tertiary oil recovery or enhanced oil recovery methods. The term "tertiary" is used since a "third crop" of oil is being produced. It is generally felt that economic incentives must be high for tertiary recovery to be applicable (11). Normally, tertiary oil recovery would be applied after primary and secondary recovery are no longer feasible, but the technique could be applied earlier in the life of an oil field.

A proposal for a research program in the area of tertiary oil recovery was made to the state government in Kansas by the Department of Chemical and Petroleum Engineering, University of Kansas, in 1973 (18). The proposal was to develop a program to provide research results and technological information on tertiary oil recovery to the Kansas oil industry as operators looked ahead to enhanced oil recovery operations in the State. Independent oil companies make up about 80 percent of the oil industry in Kansas. The Kansas Legislature appropriated funds for the Tertiary Oil Recovery Project (TORP) beginning in July, 1974.

Elements of this project are: i) to make assessments of resources; ii) establish a laboratory and conduct research; iii) perform computer modeling; iv) establish interaction with the oil field and engineering projects; and v) disseminate technical information to operators (See Appendix E).

As a part of the project, it is important to evaluate the economies of the different processes. An oil or gas investor must place a time value on his money. The question is asked, "Should an investment be made in the micellar method of tertiary oil recovery?" It is a generally accepted idea about those processes that, because of the large amount of initial investment or heavy "front-end loading" of costs, a competitive rate-of-return must be -

achieved. This must be the case for companies to invest in such a project. Also, because of the high risks in application of enhanced oil recovery methods, a higher rate of return (relative to low-risk projects) is often required.

Carey and Mathur (24) observed that the Discounted Cash Flow (DCF) method of economic analysis is the most widely used evaluation yardstick for profitability calculations. Their conclusion resulted from interviews with major oil companies. A study by Don Frost (10) confirmed their findings. Frost presented a paper which evaluated the method of economic analysis used by nine independent oil producers of Kansas. His findings revealed that eight of those companies interviewed used a discounted cash flow concept of investment analysis. Gogarty (14), performed a discounted cash flow analysis for a micellar recovery project. Economic calculations published in his paper seem to be the pioneer economic study for the micellar process.

Other literature surveyed and used for this research is discussed in Chapter 2. The concepts provided in these publications are applied to develop an economic model. The model uses a discounted-cash-flow, rate-of-return calculation to evaluate the potential economic feasibility of application of the micellar process of tertiary oil recovery in Kansas.

The objective of this study is to provide an economic model for the micellar process that can be used for actual field operations by the independent oil operators in Kansas. The desirability of providing an economic model for general use by independent oil operators within the state was one of the stimuli for this research and model development.

Chapter 2 provides a summary of the literature that was found to be pertinent in this research. Other literature is also discussed because it provided a background in establishing the concepts that apply in the economic model.

Chapter 3 is divided into four sections. Section 1 presents the general concept of a rate of return analysis. Section 2 discusses the production input data to the model. Section 3 discusses the input of the economic data and Section 4 provides a discussion of the economic model.

Chapter 4 provides the results of the model application and an analysis of those results. These analyses show effects of different economic parameters such as type of depreciation employed, capitalizing or expensing of chemicals used in the project, oil price and application of depletion allowance.

Chapter 5 proposes future work for continued economic analysis of micellar-polymer flooding. Conclusions are drawn and recommendations for application of the economic model are also provided in this chapter.

A Fortran listing of the program is contained in Appendix C, with the exception of subroutine M15A which is a portion of the program library at the University of Kansas.

CHAPTER 2

LITERATURE REVIEW

There are many different methods of analyzing the profitability of proposed capital investments. The discounted-cash-flow, rate-of-return method has been advocated as a means of discriminating among new investments. Areas covered in the investigation of literature for this research have been categorized as follows:

Micellar Process

General Economics

Production and Cost Data

Computer Modeling Economics

Discounted Cash Flow, Taxes and Oil
Property Valuation

Using these categories, the " and Gas Journal" was researched beginning in 1960, but only general background information was obtained. The "Journal of Petroleum Technology" and reprints published by the Society of Petroleum Engineers of AIME provided the most information on economics and were reviewed from 1953. A review of pertinent economic courses offered at the University of Kansas was made. The courses were taken to supplement the

author's background. Information circulars by the United States Bureau of Mines provided two important works on modeling and cost data for waterfloods. Books on general economics, methods of analysis, taxes and oil property evaluation were also researched. Periodical publications on federal taxes were reviewed and new applicable information on depletion was located. These periodicals were reviewed from the year 1970. Visits were made to the field for discussions with operators. Conversations were held with Dr. W. Barney Gogarty (14), Marathon Oil Company and W. D. Dietzman (7), U.S. Bureau of Mines in Dallas. They provided cost data and their publications and conversations proved most beneficial in building an economic evaluation background. The simulation model for the micellar process developed by Shetlar (31) provides further direction to the literature search for actual data that could be applied to his model. Pilot test results presented by Cities Service Oil Company provided input data for the micellar process simulation model (29).

Micellar Process

Shetlar's (31) thesis was used to develop an understanding of the micellar process. Various publications which he referenced were selectively reviewed to provide a background for the application of his model. The reader should use Shetlar's (31) work to expand his knowledge of

the micellar process.

Davis and Jones (5) described the micellar slug process in 1968. The composition of the micellar slug can vary. Normally, it will be composed of a surfactant, hydrocarbon, water, salt and a co-surfactant, which is usually an alcohol. In Fig. 1, a schematic representation of the micellar slug process is shown.

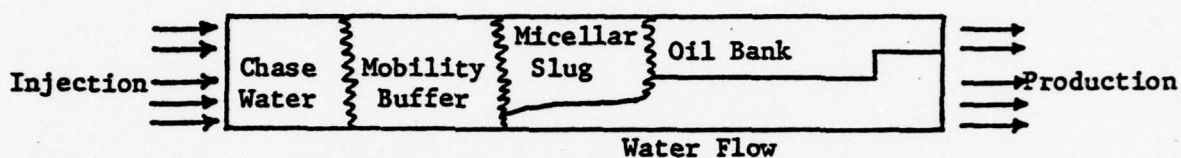


Fig. 1 - Micellar Tertiary Oil Recovery Process

The micellar slug is injected and then displaced outward from the injection wells toward the production wells. The micellar solution displaces the oil and builds up an oil bank ahead of the slug. It is not economical to fill the entire reservoir with the micellar solution so the slugs are designed for an injection quantity of five to ten percent of the pore volume for example. Following injection of the micellar slug, a mobility buffer is injected (immediate injection of water would result in the water "fingering" into the micellar slug and diluting it). The mobility buffer is usually an aqueous polymer solution, therefore, the process is often referred to as a micellar-polymer displacement. Economic constraints also limit the quantity of polymer that can be injected,

thus the mobility buffer (which may be on the order of 50% of a pore volume) is displaced by water. This water is sometimes referred to as "chase water."

General Economics

The reason for this search was to establish a background in economics. Courses were taken in the application of engineering economics. The text used was Engineering Economy by Grant and Ireson (17) which established concepts of application of depreciation, rate-of-return calculations and effects of before and after tax analysis. A course in Managerial Economics (2) supplemented a background in the field of economics.

DeGarmo's (6) book, Engineering Economy, was used to develop a background in risk analysis and rate-of-return analysis.

Carter (4) described types of formats which might be used in rate-of-return calculations. He also discussed, from an ethical viewpoint, the rationale for performing an accurate study. Glenn (12) made observations as to why investors desire to use a discounted-cash-flow method as an economic criterion for investments. His conclusions confirmed other authors' writings that the time value of money does need to be considered.

Data

Wayhan's (35) discussion of waterflooding evaluations had little direct application to this research, but did provide lifting cost data. He used 5.5 cents per barrel of fluid produced and two cents per barrel for injection costs. This study was performed on twenty-three wells in the Denver basin and was used as a check on the data gathered and used in the present model.

Cities Service Oil Company (29) published a report on the El Dorado, Kansas micellar-polymer demonstration project which is being done in cooperation with the Energy Research and Development Administration (ERDA). Reservoir data were provided in the report and these data were used as a basis for development of an example field case which was considered typical of eastern Kansas. Relative permeability to oil and water, weighted mean values of porosity, initial oil saturation, viscosities and pressure drop data were provided. Pusch (26) published data on core analysis and log data of the El Dorado micellar-polymer project. An average thickness for the formation was provided, plus averages of porosity, permeability and oil saturation from both core and log results.

Other data necessary for running Shetlar's simulation model (31) were slug mobility and polymer mobility as a function of concentration. These data were obtained by

applying the following. The total relative mobility,

$$\text{Total Relative Mobility} = k_{ro}/\mu_o + k_{rw}/\mu_w \quad (2.1)$$

$$= 1/\text{Equivalent Viscosity}$$

was calculated and plotted versus water saturation. The minimum of the curve provided the basis for design of the viscosities of the micellar slug and mobility buffer.

Trushenski, Dauben and Parrish (34) applied this technique and they, in turn, had used Gogarty's (15) approach to mobility control. Trushenski (34) provided some observations in which the minimum equivalent mobilities could be determined as the equivalent viscosities of the fluids in the region of the micellar slug. The mobility of the polymer was determined using Schurz's (30) data on resistance factors and polymer concentrations.

Geometric shape factors for Shetlar's model were obtained from Higgins and Leighton's (19) work on forecasting of waterflood performance. An inverted five spot was used.

Cost data were obtained by phone calls and correspondence to oil operators in Kansas. Gogarty's (14) evaluation of a Marathon surfactant/polymer flood in Illinois provided injection cost data and a comparison for results of calculations in the present study. Care was taken here because some of the costs quoted by Gogarty were company transfer pricing (14). Especially in the pricing of chemicals, this is the case. In a letter from

Witco, a price of about 26 cents per pound of surfactant was quoted, but total price is a function of concentration design of the micellar solution.

Dietzman (7), Bureau Information Circular 8561, provides some very good oil field production cost data on five different geographical areas. The Oklahoma data were found to be the most feasible to check against the data published by Gogarty (14) and those obtained from operators in Kansas. A report published by Lewin and Associates, Inc. (22) used the cost data by Dietzman (7). By applying a cost index, the quoted costs could be extrapolated to present time. The cost figures obtained in this manner were in acceptable agreement with the information from Kansas oil operators. The Tretolite Company provided some general cost information on treating the produced oil when simultaneous production of micellar slug or polymer occurred. Average cost for treating over the life of the project was estimated at 41.5 cents per barrel of production.

Katz (21) published techniques of reserve estimation. He also addressed the method used in determination of oil in place. This work provided some insight in the determination of the estimated quantity of recoverable oil.

Computer Modeling Economics

A visit was made to Dallas to meet with Dietzman (8) and he provided information about an economic model that

was used in connection with publication of the Bureau of Mines Information Circular 8652. His model assumed probable oil recovery and was found to be too general for application in the micellar process economic analysis.

Other works provided only background information. Herbert Scheweyer's book on Analytic Models for Managerial and Engineering Economics was found not applicable to this study. Also, Forrest A. Garb and H. J. Gray's work on A Practical Application of Digital Computers to Economic Analysis of Producing Properties provided some direction to this research.

Discounted Cash Flow/Taxes/Oil Property Valuation

Campbell (3), Miegell (25) and Hughes (20), all provided excellent insight into performing present worth calculations and related guidelines for oil property evaluation. Handling of income taxes were discussed for the federal and state levels of government. Advalorem taxes were not included in the calculation. Attendance at four meetings in 1975 with the review committee on revision of the state manual for property valuation indicated that the method of advalorem taxing was uncertain for oil properties on which tertiary oil recovery projects were being conducted. The manual for tax assessors states, in essence, that tertiary oil recovery processes should be

watched closely. Income taxes for the state are applied using the guidelines and instructions prepared by the State Revenue Office (33).

CHAPTER 3

THE ECONOMIC MODEL

RATE OF RETURN ANALYSIS

As observed by Mathur (24) and Frost (10), the discounted-cash-flow (DCF), rate-of-return method is the yardstick preferred by most oil companies when investigating a prospective investment. The chief reason for this is a time-value-of-money consideration. However, this method frequently overemphasizes time value, with the extent of overemphasis increasing with larger discount factors. Disregarding risk, use of discounted cash-flow has the advantage of showing the effect of time on earnings and accurately reflects how various ways of handling the investments will affect the economics (3).

In this method rate-of-return is defined as that interest rate that will cause the sum of the present worths of the cash-flows over the life of a project to equal zero (25). The basic equation for the rate-of-return calculation is:

$$\text{Rate of Return} = \sum_{m=0}^N \frac{\text{NETCASHF}}{(1+i)^m} = 0 \quad (3.1)$$

where: NETCASHF = the cash flow after taxes for
year m

i = the rate-of-return

N = the life of project

m = the year of investment or income.

In what follows, the method for determining a value for net cash flow after taxes for each year is outlined. The calculations begin with the quantity of oil produced. This figure is labeled the gross oil production, but this generally does not all belong to the producer because in most cases the producer does not own the mineral rights and it is necessary to make a lease contract for the right to drill the wells. A royalty must be paid which is the interest of a party in minerals in the ground where another party (the working interest) has gained the right to capture such minerals (3). The land owner's royalty is normally 12.5 percent of the gross production, thus, the working interest or net oil production is given by:

$$\text{NOPROD} = 7/8 \times \text{GOPROD} \quad (3.2)$$

where: NOPROD = the net oil production

GOPROD = the gross oil production.

When the NOPROD is known, the gross income (GINCOME) of the working interest can be defined as the price of oil times the NOPROD and is given by equation 3.3:

$$\text{GINCOME} = \text{PRICE} * \text{NOPROD} \quad (3.3)$$

where: GINCOME = the gross income

PRICE = the price of oil

NOPROD = the net oil production.

At this point in the cash flow analysis, the investments and cost must be defined. Investments and costs are normally divided into five different categories with each being subdivided into intangible costs and capitalized cost. This can be visualized as in the following table.

TABLE 1

SUMMARY OF TAX TREATMENT

<u>CATEGORY OF COST</u>	<u>TAX TREATMENT</u>
I. Site Preparation	
A. Intangible drilling and development cost, Leasehold cost	Expensed
B. Tangible cost	Capitalized
II. Drilling and Completion Cost	
A. Intangibles	Expensed
B. Tangible	Capitalized
III. Producing equipment (Tangibles)	Capitalized
IV. Gathering equipment (Tangibles)	Capitalized
V. Lease equipment (Tangibles)	Capitalized
VI. General and Administrative Cost	Expensed
VII. Lifting cost	Expensed

For the purpose of this work, there was an additional consideration relative to the method of handling the chemical cost. The question was whether chemical costs should be capitalized or expensed. Apparently, no final decision has yet been made on this question by the Internal Revenue Service. The sensitivity of the project economics to the method of handling these costs was investigated. Once these costs are determined, expensed costs in any taxable year can be calculated using equation 3.4:

$$\text{EXPENCST} = \text{LEASHCST} + \text{INTANG} + \text{LIFTCST} + \text{GACST} + \text{CHEMCST} \quad (3.4)$$

where: EXPENCST = the expensed cost

LEASECST = the leasehold cost

INTANG = the intangible costs are those costs of operating and development that have no salvage value

LIFTCST = the lifting cost

GACST = the general and administrative cost

CHEMCST = the chemical cost if expensed. If chemicals are capitalized, this value would be zero.

Then, by subtracting the expensed cost (EXPENCST) from the Gross Income (GINCOME), the gross income before taxes, depletion, and depreciation can be determined by the following equation:

$$\text{GIBTDD} = \text{GINCOME} - \text{EXPENCST} \quad (3.5)$$

where: GIBTDD = the gross income before taxes
depletion and depreciation

GINCOME = the gross income

EXPENCST = the expensed cost

At this stage in the cash flow calculation, depreciation is applied using one of the Internal Revenue Service's accepted methods. There are four main methods used. In application by industry, the tendency is to use the methods which "write off" the investment most rapidly. Straight line depreciation (20) is defined by equation 3.6:

$$\text{SLD} = \frac{\text{TANGI} - \text{SALVAGE}}{n} \quad (3.6)$$

where: SLD = the straight line depreciation charge

TANGI = the capitalized tangible investment

SALVAGE = the salvage value

n = the estimated useful life of the
tangible investment, years.

The straight line method is the oldest, simplest, and most generally used method of computing depreciation. If intangible costs are capitalized, they can only be depreciated by this method. It is permissible to apply this method to either new and/or used equipment or facilities (20).

Sum-of-the-years-digits method of depreciation permits an accelerated depreciation during the early life of the project (20). In general, it is only applied to single asset accounts. The equation used for applying this method of depreciation is:

$$SYOD = \frac{\text{Diff} \times (NN)}{(n^2 + n)/2} \quad (3.7)$$

where: SYOD = the sum of the years digits

Diff = the difference between the original cost and the salvage value

NN = the remaining useful life in years at beginning of taxable year

n = the estimated useful life of the facilities in years.

The calculation, given by equation 3.7, is done by multiplying the tangible investment by the life of the investment minus the depreciable year and then dividing by the sum of the years up to the depreciable life (8).

A third method of depreciation is double declining balance. The double declining balance method does not consider salvage value in the calculations. This method is generally felt to be more "in line" with oil production facilities than straight line depreciation. The maximum rate of depreciation under this method cannot exceed 200% of the straight line rate. This depreciation, once it is set, cannot be changed in the declining balance method

unless the Internal Revenue Service has given its consent (20). The equation used to calculate double declining balance depreciation is:

$$DDB = \frac{\text{Diff} \times 2.00}{n} \quad (3.8)$$

where: DDB = the double declining balance depreciation charge

Diff = the difference between the initial investment and the cumulative depreciation charge, i.e., the undepriciated balance

n = the depreciable life.

It is noted that the double declining balance method will not depreciate an asset to a zero value.

The last method considered is double declining balance with conversion to straight line. In this method, equation 3.8 is applied and at the point where the quantity depreciated is less than that calculated using straight-line depreciation, the method is switched to equation 3.6 for the remaining years. This is the most accelerated method of depreciation and it is used to maximize the rate-of-return. Once this switch has been performed, a change of method back to double declining balance cannot be made (20).

Once the depreciation charge is calculated, the net income before state and federal income tax can be determined (NIBFSIT). The equation used is:

$$\text{NIBFSIT} = \text{GIBTDD} - \text{DEPRSHUN} \quad (3.9)$$

where: NIBFSIT = the net income before federal and state income taxes and before depletion

GIBTDD = the gross income before taxes, depreciation and depletion

DEPRSHUN = the depreciation charge for the year considered.

The tangible investment is also determined for each year. The total tangible investment cost (TTICST) is equal to the tangible investment during the year plus any chemical costs (CHEMCOST), if they are capitalized, and minus any salvage value returned in that same year. One of the three equations would apply.

$$\text{TTICST} = \text{TANGIBLE} + \text{CHEMCOST} - \text{STSALVAG} \quad (3.10)$$

$$\text{TTICST} = \text{TANGIBLE} + \text{CHEMCOST} \quad (3.11)$$

$$\text{TTICST} = \text{TANGIBLE} - \text{STSALVAG} \quad (3.12)$$

where: TTICST = the total tangible investment

TANGIBLE = the tangible investment in the year considered

CHEMCOST = the chemical cost if capitalized

STSALVAG = the salvage value returned during the year considered.

Congress modified the depletion allowance law making percentage depletion applicable only to relatively small producers. In addition, a new taxable income limitation was applied in the case of small producers. To be eligible for the 22 percent statutory depletion allowance, a company must produce less than 2000 barrels per day. The percentage depletion may not exceed 65 percent of net taxable income computed without regard to the depletion allowance (32).

Depletion allowance is determined as follows.

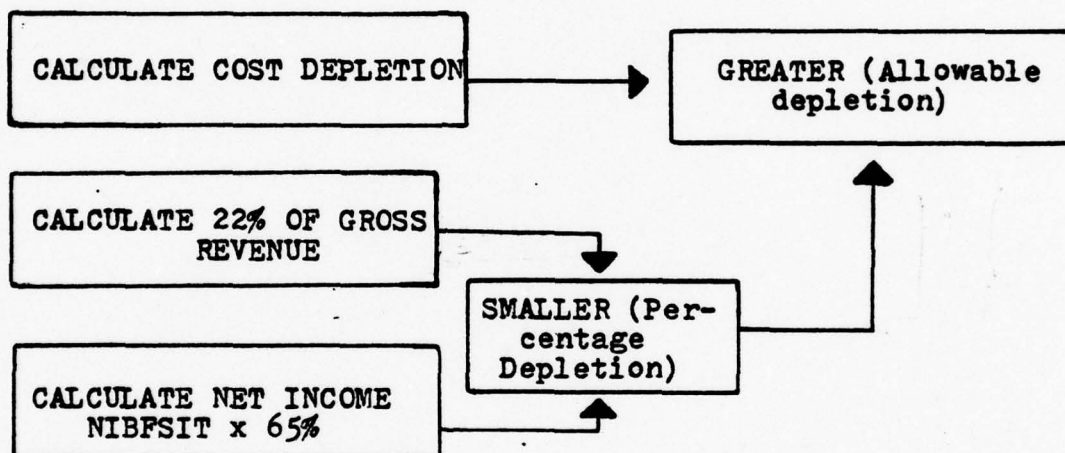


Fig. 2. - Calculating Allowable Depletion Allowance

NIBFSIT was defined by equation 3.9. Using Figure 2 as a flow diagram, the cost depletion is determined first by equation (3.13):

$$\text{CSTDEPL} = \text{BASIS} \left(\frac{\text{PRODSOLD}}{\text{RECUNITS} + \text{PRODSOLD}} \right) \quad (3.13)$$

where: CSTDEPL = the cost depletion

BASIS = the uncapitalized or non-expensed intangible expenses remaining at the end of the tax period

PRODSOLD = the units of oil sold during the tax period

RECUNITS = the recoverable units of oil at the end of the period.

The basis is normally made up of the leasehold cost, but since most of the tertiary oil recovery projects would be applied to secondary recovery areas, leasehold cost would be zero. This would result in cost depletion being zero (3).

The other part of the calculations for determining allowable depletion is the determination of percentage depletion. The net depletable income is determined by the equation:

$$\text{NDEPI} = .65 \times \text{NIBFSIT} \quad (3.14)$$

where: NDEPI = the net depletable income

NIBFSIT = the net income before federal and state taxes.

The third equation used for calculating allowable depletion is to determine 22% of gross income (GINCOME). This is the last equation necessary to complete the flow of Figure 2.

$$\text{PERCENTG} = .22 \times \text{GINCOME} \quad (3.15)$$

where: PERCENTG = the percentage of gross income

GINCOME = the gross income.

Now the smaller value of NDEPI or PERCENTG will equal percentage depletion (PERDEPL). The greater of cost depletion (CSTDEPL) and percentage depletion (PERDEPL) will equal the allowable depletion (ALDEPLA).

State income taxes must be determined next. The State of Kansas has a law that allows the tangible investments in tertiary recovery projects to be amortized over a twenty-four month period (1). This bill (House Bill 2694) became a Kansas law in 1976. This law is applied to determine the income for state taxes. A straight line depreciation method is utilized applying equation 3.6 for only a two year life period per investment category. This value is subtracted from gross income before taxes, depreciation, and depletion. This equation is:

$$\text{TAXINC} = \text{GIBTDD} - \text{STAMORTS} \quad (3.16)$$

where: TAXINC = the taxable income for state taxes

GIBTDD = the gross income before taxes, depreciation and depletion

STAMORTS = the amortization of tangible investments, computed using a two-year straight line depreciation.

Once a taxable income is determined, then the state tax factors can be applied. The state tax schedule, INC Form 120S for small business corporations has a normal tax factor of $4\frac{1}{2}\%$ and an additional surtax of $2\frac{1}{4}\%$ for all income over \$25,000 (33). State income tax is then determined by the equation:

$$\text{STITAX} = .045 \times 25,000 + .0675 \times (\text{TAXINC} - 25,000) \quad (3.17)$$

where: STITAX = state income tax

TAXINC = taxable income.

To complete the determination of net cash flow, federal income taxes must be determined. The federal taxable income is calculated by using the results of equations 3.9, 3.17 and allowable depletion (20).

The equation used is:

$$\text{FEDTAXIN} = \text{NIBFSIT} - \text{ALDEPL} - \text{STITAX} \quad (3.18)$$

where: FEDTAXINC = the federal taxable income

NIBFSIT = the net income before taxes and depletion

ALDEPL = the allowable depletion

STITAX = the state income tax.

Then federal income tax is equal to 48% at the federal taxable income (17). The equation used is:

$$\text{FEDINTAX} = \text{FEDTAXIN} \times .48 \quad (3.19)$$

where: FEDINTAX = the federal income tax

FEDTAXIN = the federal taxable
income.

All equations must be applied unless depletion allowance is not considered and then a value of zero is inserted for depletion allowance. The results of a present worth calculation are shown in Appendix F. All of the above equations are applied on a yearly basis and then equation 3.1 is used to determine a DCF-rate-of-return.

PRODUCTION DATA

In trying to develop a set of data that was "typical" of a Kansas eastern field, the approach used was to search out published data, call directly to operators, and make direct field visits.

Oil and fluid production data required for the calculations were derived using the model of the micellar process developed by Shetlar (31). The model is a "first pass" plug flow simulation which was patterned after the Higgins and Leighton waterflood model (19). The data for Shetlar's model were obtained from a study of the "El Dorado Micellar-Polymer Demonstration Project," by Cities Service Oil Company and the United States Energy Research and Development Administration (ERDA) (29). The assumed injection

project for this study was a hypothetical 650-acre portion of the 6400 acres in the El Dorado field. An inverted 5 spot on a 5-acre spacing was used as the development pattern. The pattern layer and spacing used in the calculation employed 128 injection wells and 153 production wells. Table 2 provides a summary of data input parameters.

These data for this example calculation were formulated in the following fashion. Oil viscosity, water viscosity, porosity, initial oil saturation and relative permeabilities were obtained from weighted averages provided by Cities Service Oil Company (29) and confirmed by Pusch (26) from both core and log analysis. Figure 3 shows the relative permeabilities to oil and water used. The value for pressure drop in the injection process was calculated assuming a fracture gradient of approximately .61/ft of depth could not be exceeded. Therefore, for this test case, 400 psi was used as the pressure drop from injection wells to production wells. Shetlar's (31) model requires values of water saturation and bypassed water saturation behind the micellar front. These data were estimated using Davis and Jones' observations on macroscopic flow behavior in core lab tests (5). For more precise estimates, the fractional flow of oil and the leaky piston equations can be applied (18). The sizes of the micellar and polymer slugs were based on laboratory experience reported in the literature (13).

TABLE 2
SUMMARY OF INPUT DATA FOR THE SIMULATION
MODEL OF THE MICELLAR PROCESS

Oil Viscosity, cp	4.77 cp
Water Viscosity, cp	1.02 cp
Pressure Drop, psi	400 psi
Absolute Permeability, md.	200 md
Porosity	0.262 Fraction
Initial Oil Saturation	0.28 Fraction
Bypassed Water Saturation	0.20 Fraction
Bypassed Water Saturation after Water Invasion	0.30 Fraction
Design Micellar Slug Size	0.10 Pore Volumes
Design Polymer Slug Size	0.70 Pore Volumes
Convergence Criteria	0.00001
Number of Channels	4
Number of Cells	40
Non Linear Indicator	0
Equivalent Viscosity	7.6173 cp
Bulk Volumes of each Channel	
#1	6090.2325 ft ³
#2	6746.355 ft ³
#3	7917.030 ft ³
#4	6471.383 ft ³
Equivalent Mobility of Micellar	.13128 cp ⁻¹
Equivalent Mobility of Polymer	
Batch #1	.66250 ⁻¹
Batch #2	.08333 cp ⁻¹
Batch #3	0.12500 cp ⁻¹
Design Water Volume	0.0800 pore volumes
Multiplicative Factors	152.00 ft.

TABLE 3

RELATIVE PERMEABILITIES
WATER SATURATION
TOTAL RELATIVE MOBILITIES
AND EQUIVALENT VISCOSITIES

K_{ro}	K_{rw}	S_w %	Total Relative Mobility 1/cp	Equivalent Viscosities cp
1.00000	0.00001	25.00	0.2096530	4.769
0.85000	0.00040	27.29	0.1885890	5.302
0.78000	0.00800	29.59	0.1713650	5.835
0.67000	0.02000	31.88	0.1600690	6.247
0.57000	0.03400	34.18	0.1528300	6.543
0.48000	0.04500	36.47	0.1447460	6.908
0.40000	0.05800	38.77	0.1407200	7.106
0.31000	0.07000	41.06	0.1336169	7.484
0.27000	0.07700	43.36	0.1320939	7.570
0.21000	0.08900	45.65	0.1312800	7.617
0.17500	0.09900	47.95	0.1337464	7.477
0.12500	0.11000	50.24	0.1340480	7.460
0.10000	0.12000	52.54	0.1386114	7.214
0.07500	0.13000	54.83	0.1431740	6.984
0.04800	0.14800	57.13	0.1551600	6.445
0.03300	0.16000	59.42	0.1637809	6.106
0.02100	0.18500	61.72	0.1857750	5.383
0.01350	0.20000	64.01	0.1989086	5.027
0.00650	0.22500	66.30	0.2219509	4.505
0.00330	0.25000	68.60	0.2457890	4.068
0.00076	0.28000	70.90	0.2746690	3.640
0.00001	0.30000	72.00	0.2941190	3.399

TABLE 4

TEST CASE #1. 650 Acre Micellar-Polymer
Slug Process for the Development of Basic Economic Input
Parameters

FIELD DATA:

Location = South Central Butler County, Kansas
Field = El Dorado
Producing
Sand = El Dorado Shallow (Admire)
Area = 650 Acres, developed on 5 acre spacing
Average
Thickness = 19 feet
Porosity = 26.2 percent
Initial
Oil
Saturation = 28.0 percent
Pattern = Inverted 5 spot
Injection
Wells = 128
Production
Wells = 153
Depth = 650 feet

FLUID INJECTION DATA:

Micellar Solution Slug = 8 percent of pore volume
Mobility Buffer = 70 percent of pore volume
Batch size of polymer
 #1 = 20 percent of 400 ppm
 #2 = 20 percent of 250 ppm
 #3 = 30 percent of 100 ppm
Water Injection = 80 percent of pore volume

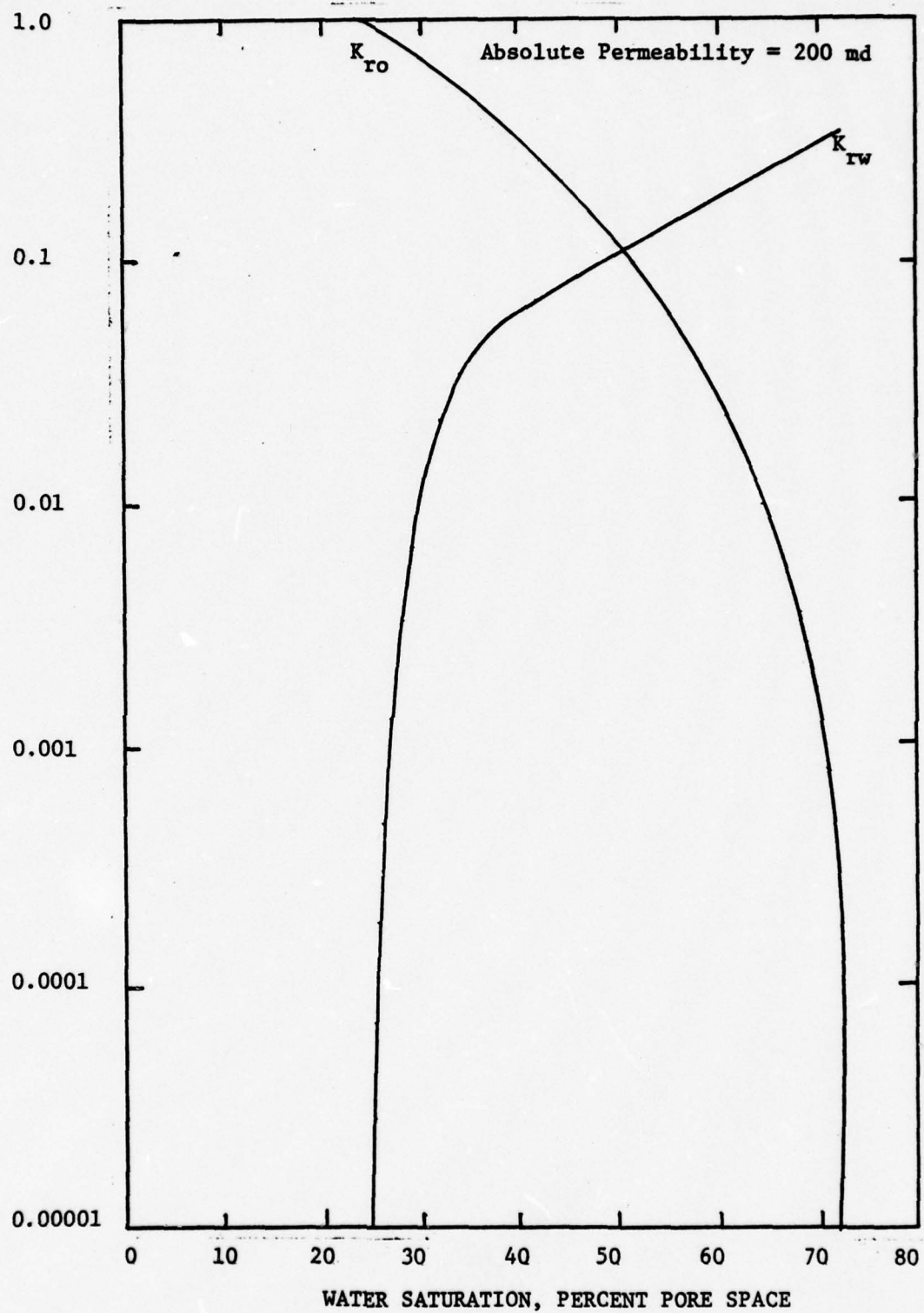


Fig. 3 - Relative Permeability Fraction Versus Water Saturation

A four channel, 40 cell non-linear system was used in the flow model. Shetlar used .00001 as a convergence tolerance and the case reported here was run using the same criterion. Each channel volume was calculated using equation 3.20.

$$\text{Bulk Volume} = \frac{\text{Pattern Size(Acre)} \times 43560 \text{ ft}^2/\text{Acre} \times \text{Unit Thickness}}{\text{Number of pattern elements}}$$

$$\text{Channel \#1 Bulk Volume} = \frac{5 \text{ acre} \times 43560 \text{ ft}^2/\text{acre} \times 1 \text{ ft}}{8} (.2237) \quad (3.20)$$

$$\text{Channel \#1 Bulk Volume} = 6090.2325 \text{ ft}^3$$

The value .2237 is the fraction of the total bulk volume occupied by channel one. The other channel volumes are determined in a corresponding manner.

The next task was to determine the equivalent viscosity that would provide a "safe" mobility ratio to reduce the possibility of fingering during the displacement process. The total relative mobility was determining using the equations:

$$\text{Total Relative Mobility} = \frac{K_{ro}}{\mu_o} + \frac{K_{rw}}{\mu_w} \quad (3.21)$$

where: K_{ro}/μ_o = the mobility of oil

K_{rw}/μ_w = the mobility of water.

The total relative mobility can be calculated as a function of water saturation when relative permeabilities are available. The minimum in this value is used as the design mobility of the micellar slug and polymer buffer so that mobilities of the micellar solution and the mobility bank are equal to or less than the oil-water mobility (34). This value is equal to the reciprocal of equivalent viscosity. The determined values of the relative mobility are listed in Table 3. Figure 4 is a graphical presentation of total relative mobility versus water saturation. It should be noted that equivalent viscosity is equal to resistance factor in polymer flow. The equation used to determine resistance factor is:

$$RF = \frac{k_w/\mu_w}{k_p/\mu_p} \quad (3.22)$$

where: RF = the resistance factor

K_{rw}/μ_w = the relative mobility of water

K_{rp}/μ_p = the relative mobility of polymer.

Schurz (30) provided a graphical presentation of resistance factor as a function of polymer concentration. Using Figure 5 and the stipulation that three batches of polymer were desired for injection, the concentrations of polymer batches were determined. These concentrations were estimated at 400 ppm, 250 ppm and 100 ppm which are

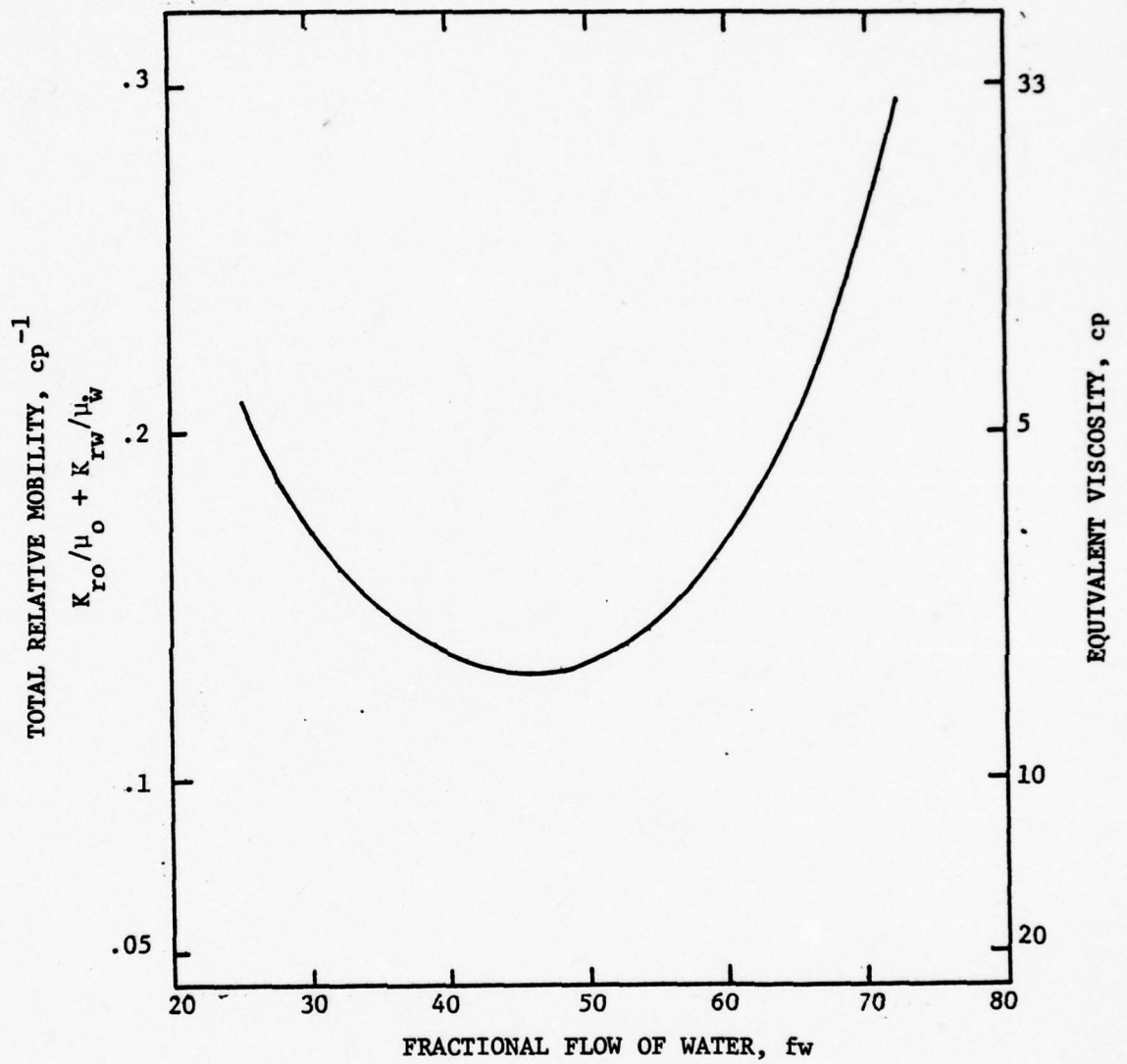


Fig. 4 - Relative Mobility of Fluids in El Dorado Shallow 650' Sand

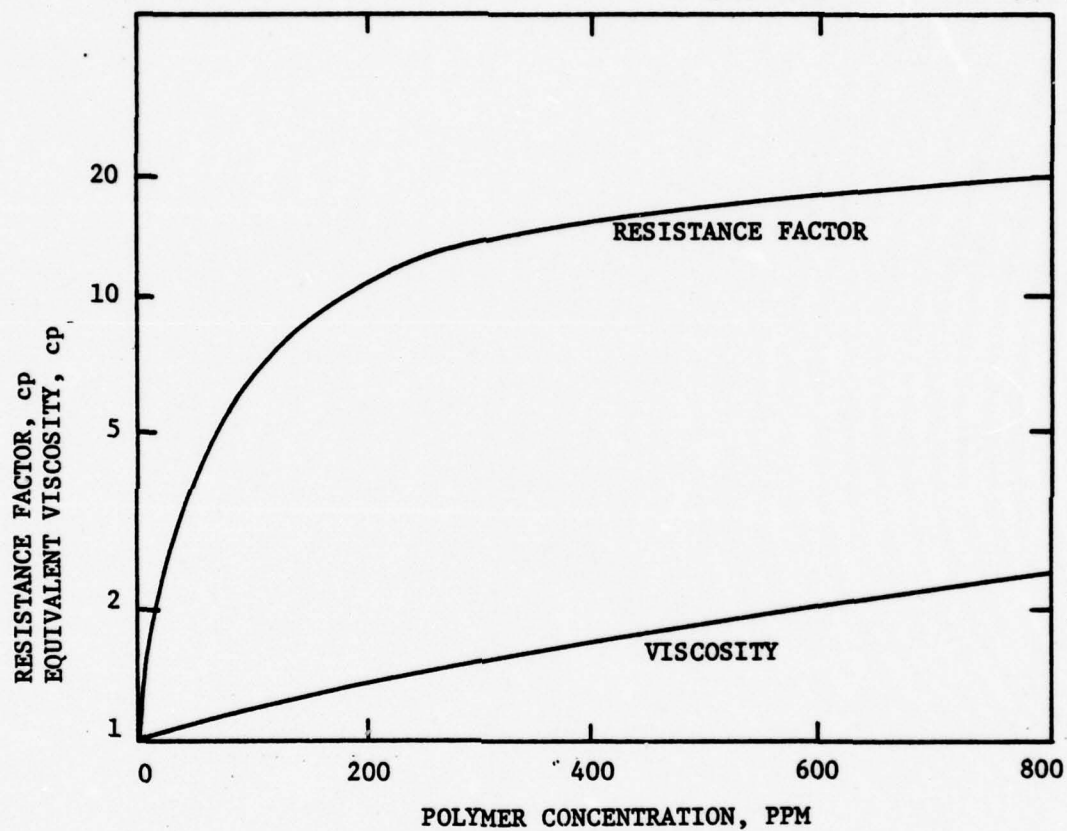


Fig. 5 - Resistance Factor and Relative Viscosity to Brine
at HPAM-700 (30)

all above the minimum resistance factor of 7.617. At this point, a decision was made to set the polymer batch sizes at 20, 20 and 30 percent pore volume giving an overall polymer slug size of 70 percent of a pore volume. This has a definite effect on the economics and efficiency of the process.

The water injection behind the mobility buffer was put at 80% of a pore volume. This could be controlled during actual operation since it is performed as the last phase of the project. Water injection would then be dependent upon the production economics.

One other data input to the model was a multiplicative factor to control oil recovery. In the model 100% oil recovery occurs at points reached by the micellar slug and therefore, to be realistic, the production was reduced to efficiencies of 40, 50, and 60 percent recovery. Chapter 4 includes a discussion of the effects of different recovery efficiencies. The model is designed to compute recovery for one pattern. Multiple pattern results are obtained by simply multiplying model results by the number of patterns.

ECONOMIC DATA

The economic data used in the economic model were obtained by direct phone conversations and letters to drilling companies operating in Kansas. Published cost

data by the U.S. Bureau of Mines (7), published inflation factors by Lewin Associates Inc. (22) and direct contact with oil operators were used to justify cost data. Table 4 summarizes the input field and fluid injection data. Table 5 summarizes the economic data as applied to this model. Gogarty's (14) presentation provided some unit cost data for the handling of the micellar slug and polymer and water. Treating costs were obtained from the Tretolite Company in St. Louis, Missouri. The price of oil was taken as \$11.90, but the model is capable of applying variable prices. The lifting cost was set at 3.2 cents per barrel of total fluid produced. The general and administrative costs were calculated at \$70 per well/month and applied to the total fluid quantity produced.

It should be noted that if comparisons are made between these cost data and Gogarty's (14), the main differences are chemical costs for micellar and polymer. In Gogarty's paper, these are based on inter-company transfer pricing (2).

ECONOMIC PROGRAM

Specifics of the computer program reported in this thesis are presented in the appendices. Appendix B lists the variable names and defines each used in the program. A listing of the FORTRAN program and subroutines, with the exception of the plot routines which are a part of

TABLE 5

BASIC ECONOMIC INPUT PARAMETERS FOR THE
DEVELOPMENT OF 650 ACRES OF THE EL DORADO FIELD

CONDITIONS:

1975 - 1976 Costs and Prices
Application of Lewins (22) Inflation Factors

FIELD COSTS:

	<u>Tangibles</u>	<u>Intangibles</u>	<u>Total</u>
Plant	\$585,000	\$195,000	\$780,000
Production & Development Cost	780,000	390,000	1,170,000
Drilling and Completion Costs	1,351,610	2,301,390	3,653,000

UNIT COSTS:

Crude oil price	=	\$11.90/bbl and a variable
Micellar solution slug	=	\$8.50/bbl
Slug Injection Expense	=	18.4¢/bbl
Polymer	=	\$2.00/lb
Batch @ 400 ppm	=	28¢/bbl
Batch @ 250 ppm	=	17.5¢/bbl
Batch @ 100 ppm	=	7¢/bbl
Polymer Injection Expense	=	4.1¢/bbl
Water Injection Expense	=	2.6¢/bbl (includes purchase price)
Lifting Costs	=	3.2¢/bbl of total fluid produced
Water Disposal Expense	=	2.6¢/bbl
Treating Expense	=	41.5¢/bbl of oil produced during production of micellar or polymer solutions

ROYALTY AND TAX DATA:

Royalty	=	12.5 percent
Income tax - Federal	=	48 percent
State	=	6.75 percent

the University of Kansas program library, is given in Appendix C. Appendix D provides an explanation of the input variables and card formats. Results of a test run are presented in Chapter 4 and output is in Appendix F. A simplified Flow Chart is presented in Figure 6.

The program is designed to receive input data from a production decline curve or a simulation model of the micellar slug process. For the test case used here, the input data of gross oil production, micellar slug quantity injected and polymer quantity injected in the test case were obtained using the model designed by Shetlar (31) as previously described.

The program has eight different switches which allow the user to look at the effect of capitalizing or expensing chemicals, types of depreciation, application of depletion allowance and price variation. The program allows for tangible investments to be made in any year and also to have depreciable lives of 5, 10, 15, 20, and 25 years.

If the chemical code (CHEM) is 1, the micellar slug and polymer injected are expensed in the program. For this case, expense cost would be the sum of lifting costs, chemical cost, general and administrative cost, and intangible cost. If (CHEM) code is 2, the micellar slug and polymer injected would be capitalized and considered as a tangible cost. This option on handling of chemicals is provided because an Internal Revenue Service decision as

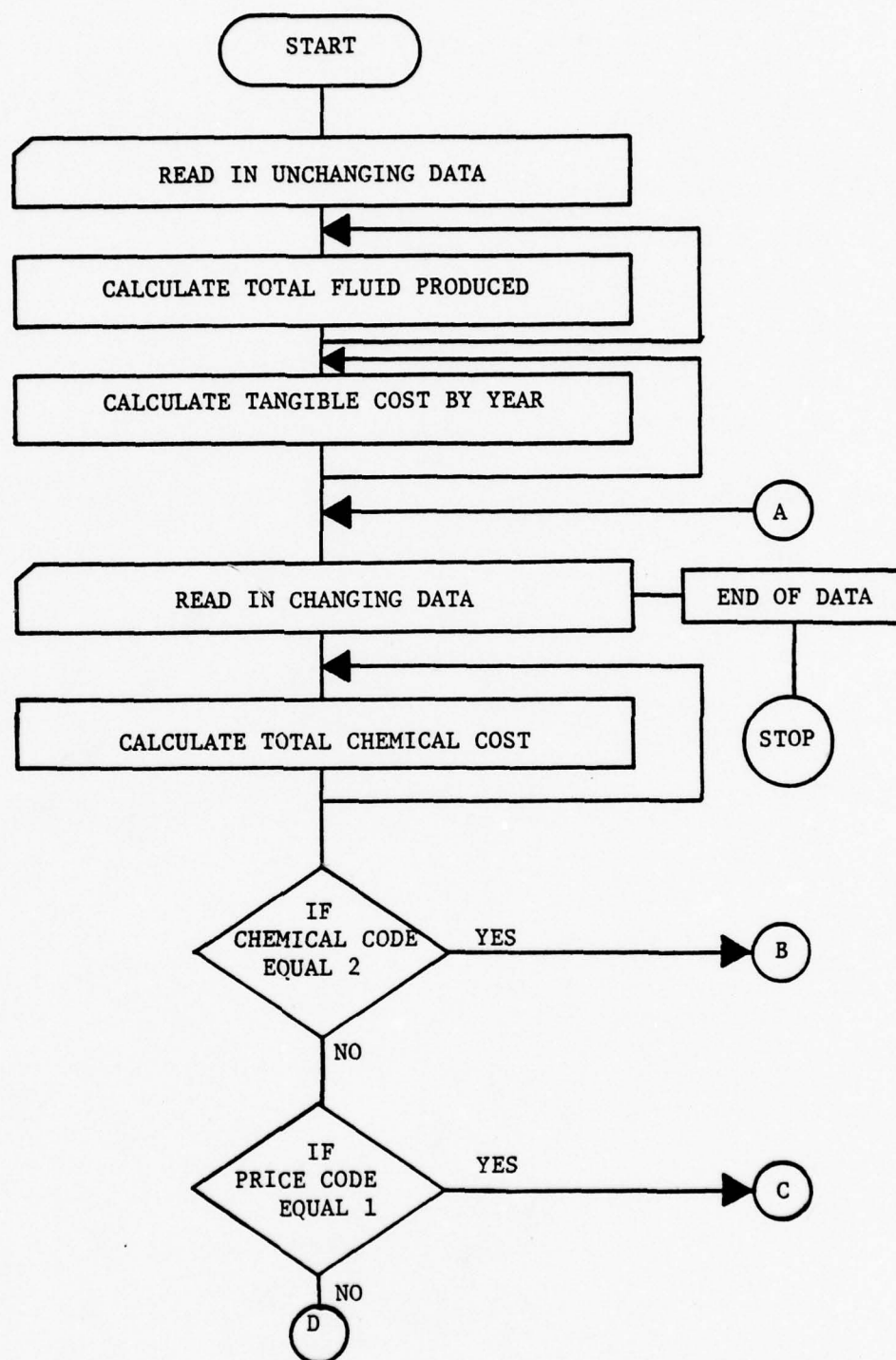
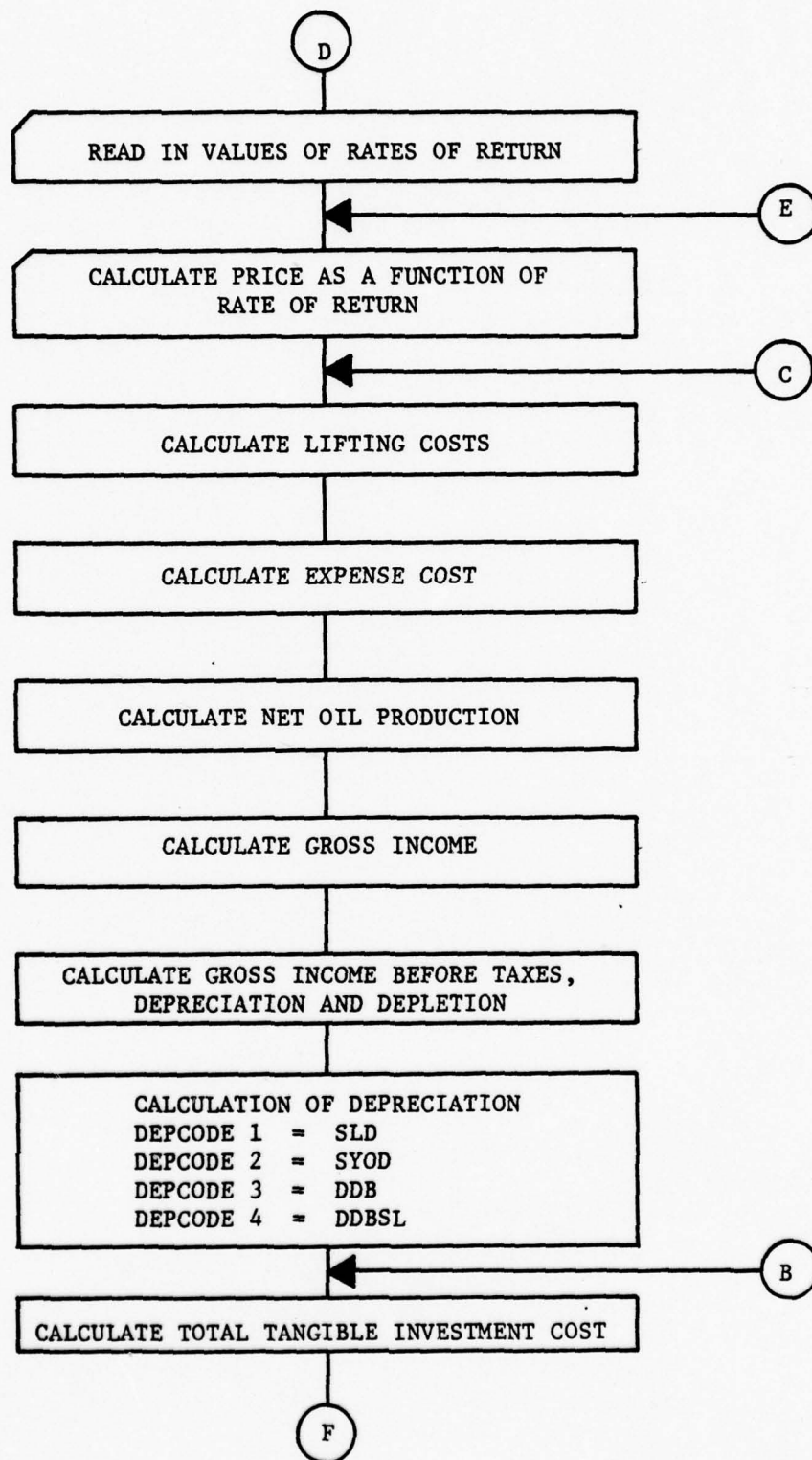
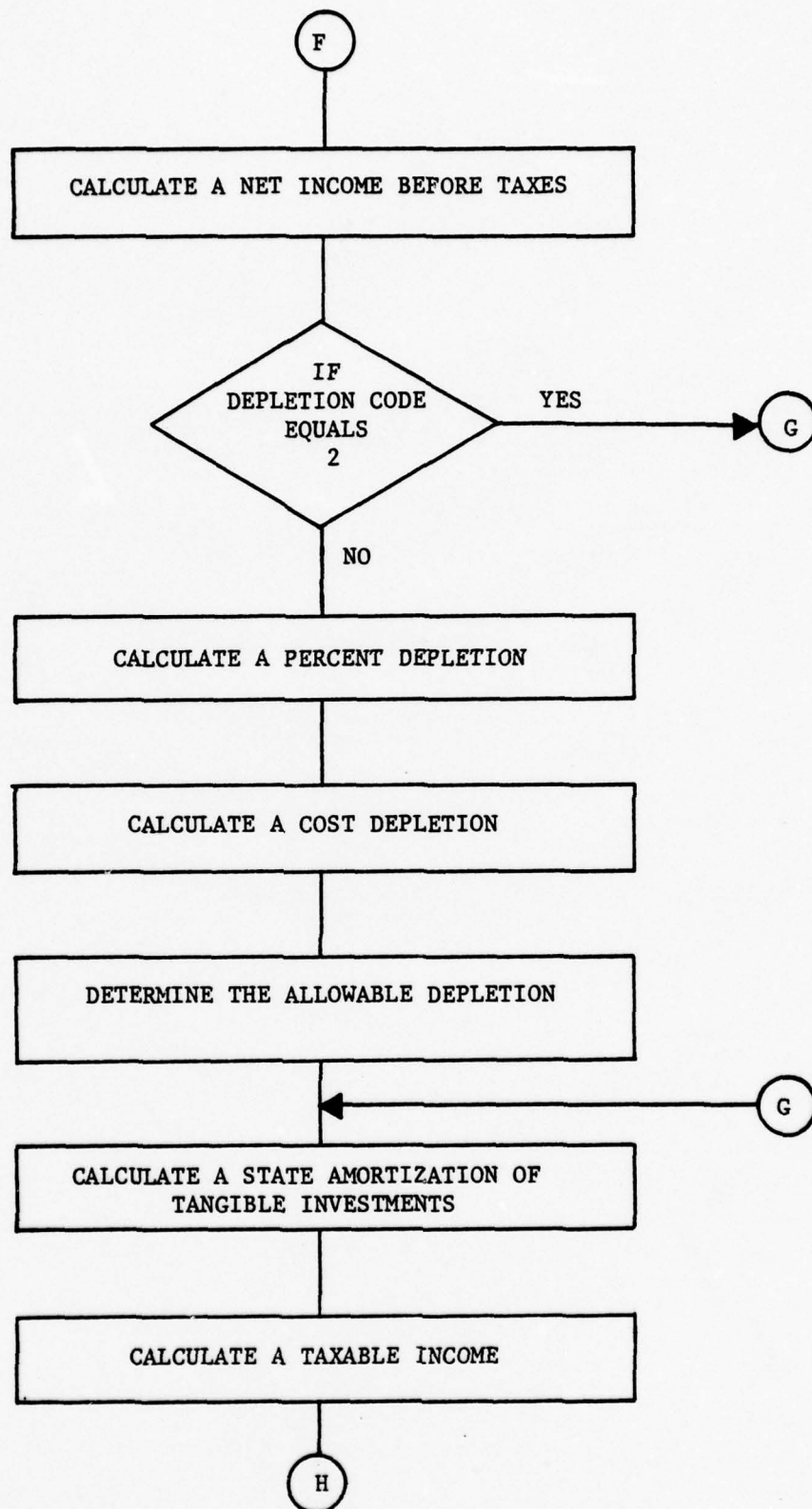
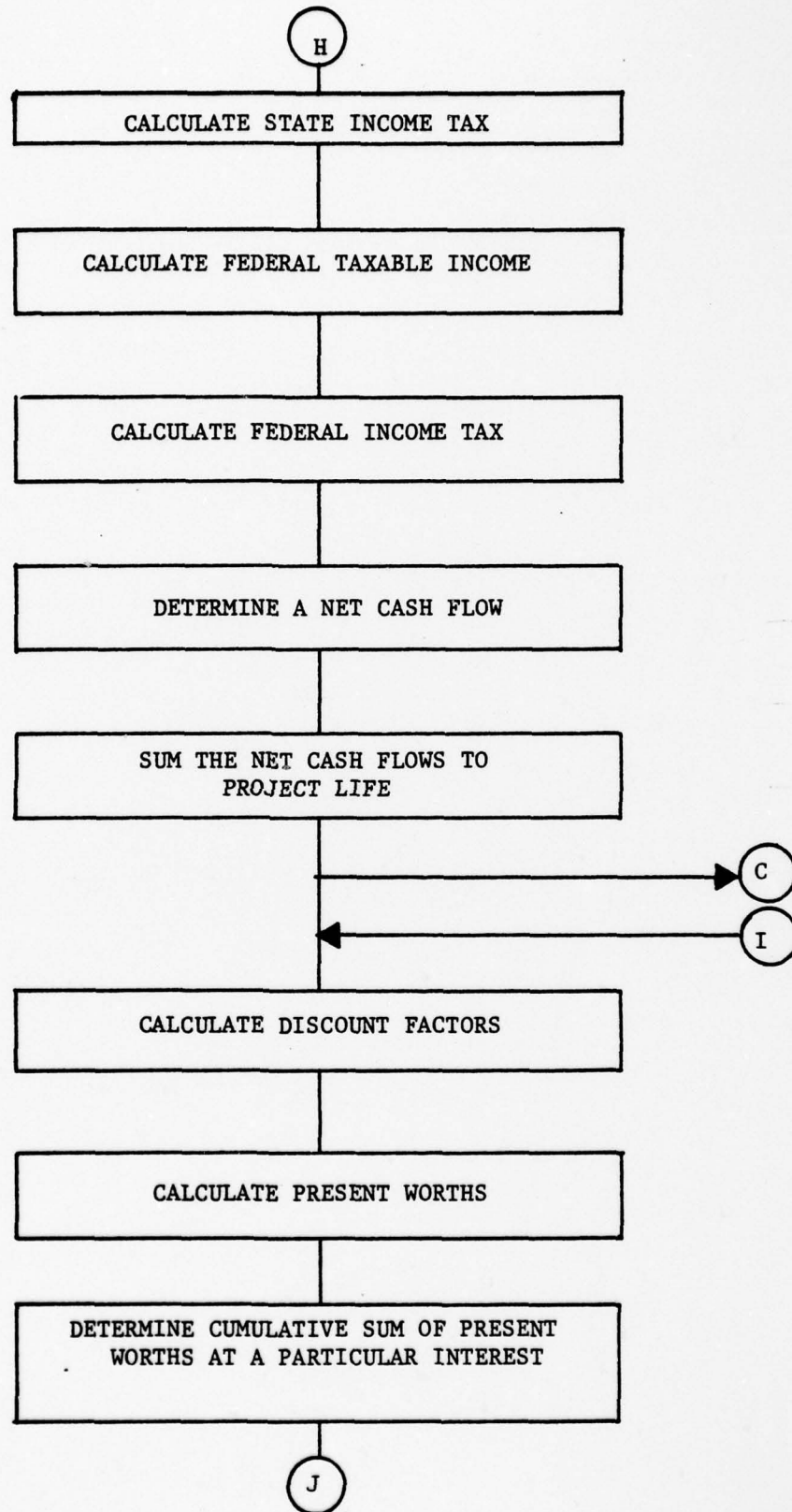
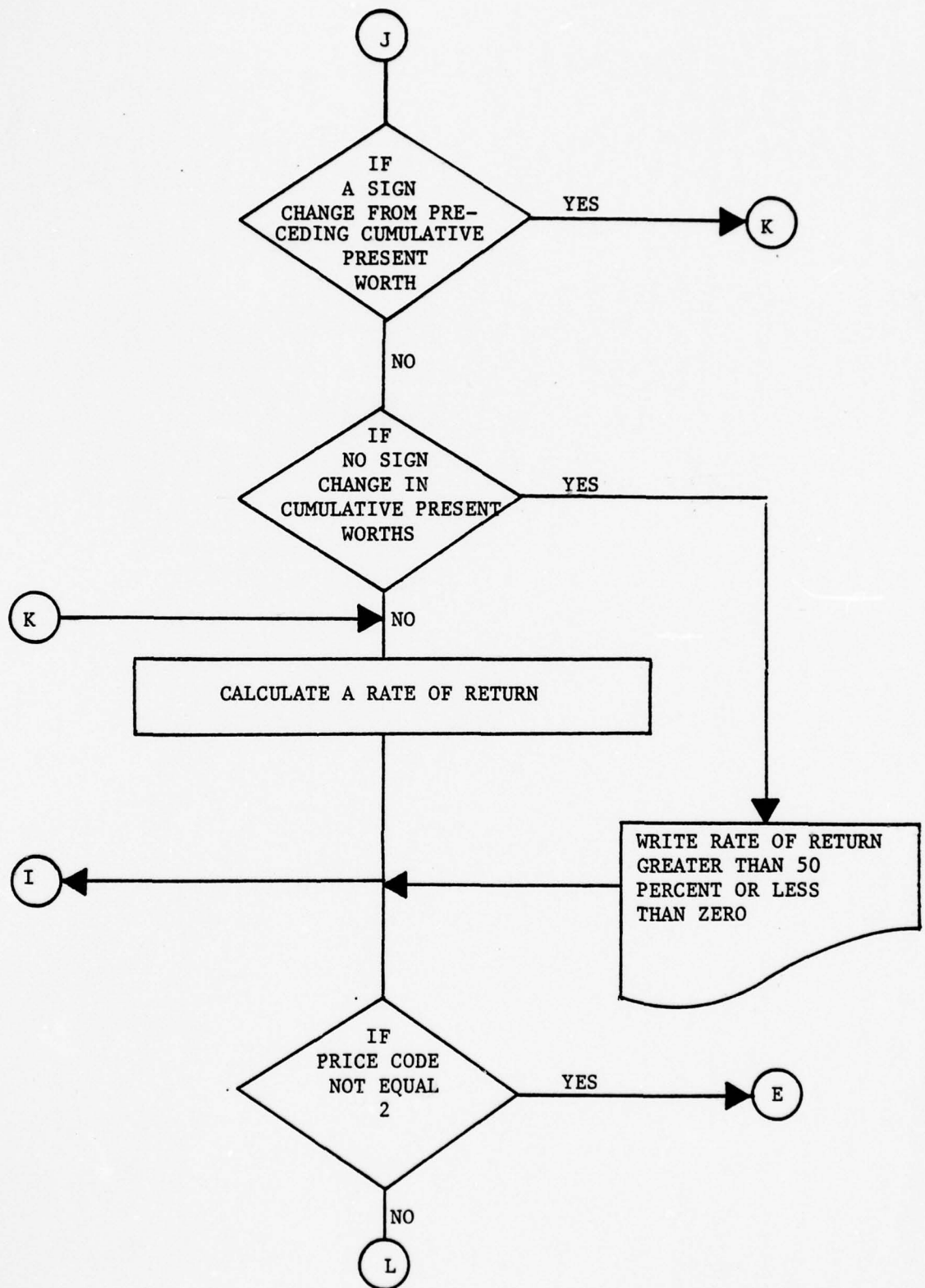


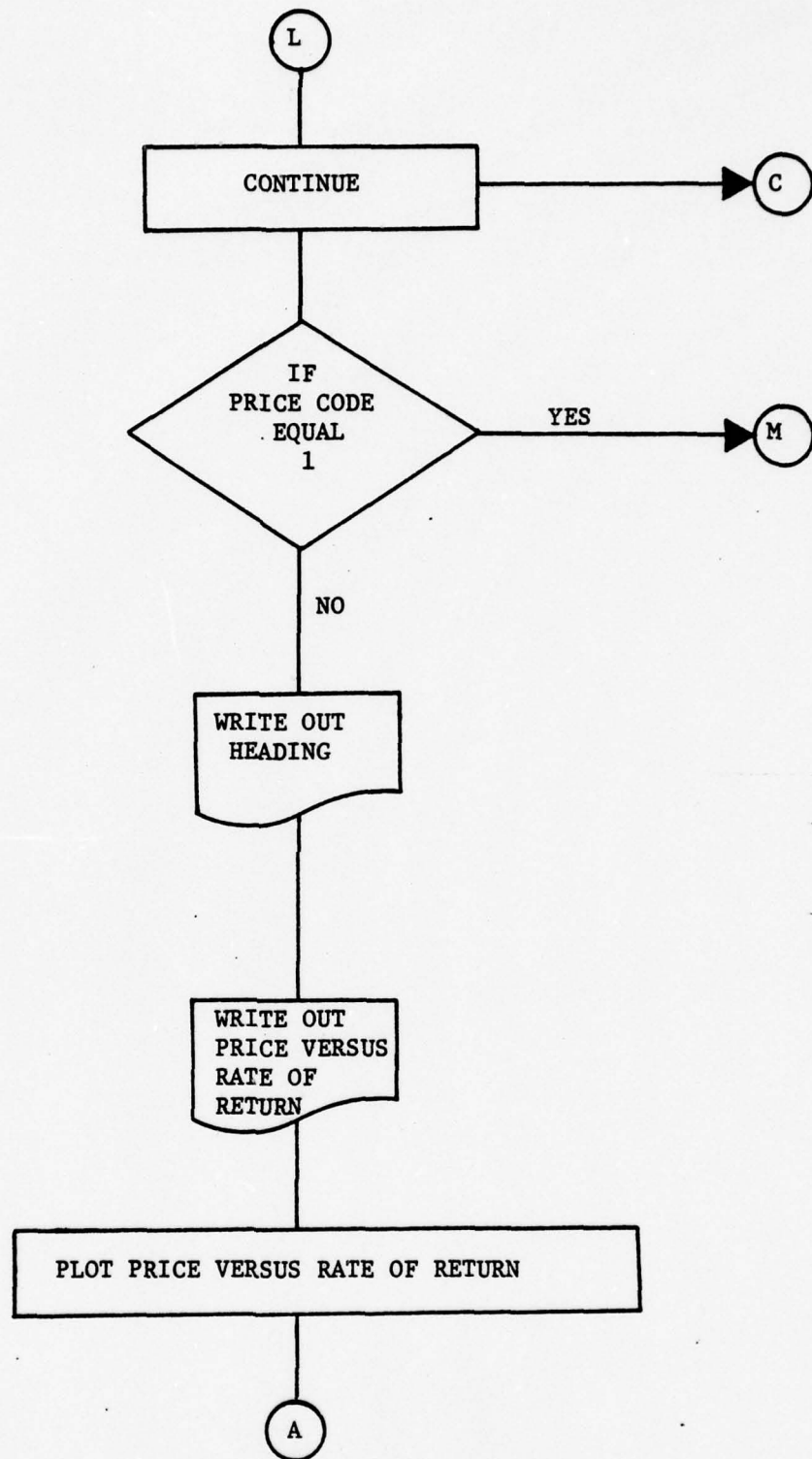
FIGURE 6. Simplified Flow Chart for the Computer Program

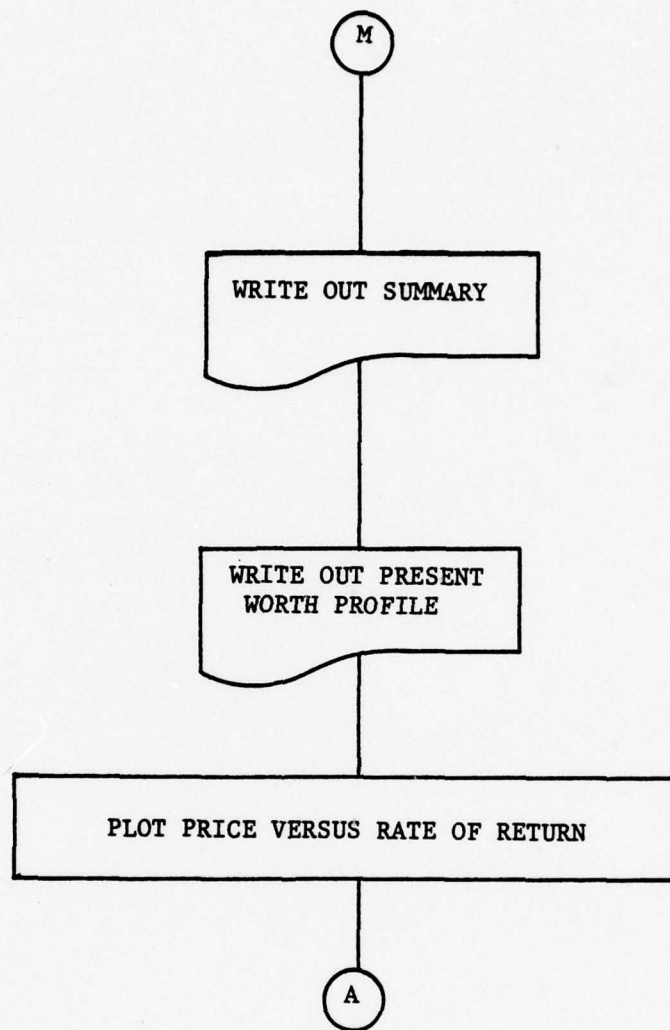












to the tax treatment of injected chemicals has not been finalized. The method of handling chemicals for tax purposes is an important question. Tangible costs are those costs that have a salvage value. It is generally believed, at this point in the technology development, that chemicals injected into a reservoir have no salvage.

A second code (PRICECD) is used to allow the program to switch to alternate calculation procedures. Price Code 1 will cause the program to compute a present value profile for a set oil price. A price code of 2 will cause the program to calculate the price at which oil must be sold to obtain a specified rate-of-return. The derivation of the equation used in calculating the price to reach the desired rate-of-return is shown in Appendix A.

A third switch is a depreciation code (DEPCODE). This code causes the program to call a certain depreciation subroutine. A switch value of 1 calls the straight-line depreciation method. It provides for an equal yearly recovery of any one tangible investment during its life (20, 27). A depreciation code of 2 causes the program to call a subroutine which uses the sum-of-the-years-digits depreciation method. This method is somewhat more accelerated in depreciation rate than straight line depreciation. A depreciation code of 3 calls the double-declining-balance subroutine. This method of depreciation, in essence, doubles the rate of depreciation for the undepreciated

value of the investment. It never depreciates the asset to a zero value. Therefore, if in the last year of the depreciable life, the salvage value is considered to be zero, the remaining undepreciated value is written off (3). When the depreciation code is 4, the program calls the double declining balance method with conversion to straight line depreciation. This subroutine performs the calculation by initially using double declining balance. When the double declining balance is less than straight line depreciation, then straight line depreciation is applied. Once conversion is applied for that investment, double declining balance cannot be reapplied (29). Equations for these different methods of depreciation are 3.6, 3.7, and 3.8.

The next switches considered in the program are depletion codes (DEPLCODE). This allows for percentage depletion allowance to be applied or disregarded. A switch value of 1 causes depletion allowance to be applied and a code 2 results in the calculation being bypassed. Cost depletion is considered in all cases to recover any leasehold cost incurred by the developer.

The program next calculates state income tax. It is based on a tax factor applied to the gross income before taxes, depletion and depreciation minus the tangible investment amortization over a twenty-four month period. The factors applied are .045 for taxable income less than 25,000.00 and .0675 for taxable income over \$25,000.00 (33).

Federal taxable income is then determined and a tax factor of 48 percent is applied. Then, net cash flow is the result of the algebraic sum of gross income less expense cost, leasehold cost, total tangible cost, state taxes and federal taxes for any tax accounting year.

Present worth of the yearly cash flows is then calculated using interest rates of 5 to 50 percent in 5 percent increments. The discount factor for each year is determined by applying the single payment present worth factor (12). This equation is:

$$DCF = 1/(1 + i/100)^m \quad (3.23)$$

where: DCF = Discount Factor

i = discount interest rate in percent

m = the year of tax accounting

and is a segmental part of equation 3.1. In the program this factor is multiplied times the net cash flow for the year. Cumulative sums of the present worths at the end of the project life are calculated. The project rate-of-return is determined by assuming that the rate-of-return lies between zero and 50 percent. Present worth values at the different discount rates are examined to determine if a sign change from plus to minus occurs. If no sign change occurs, then the rate printed out is zero, which simply indicates that the value is not between zero and 50%.

Subroutines Summary and Output are used to summarize the input data and provide a present worth profile. A plot routine, M15A, is called from the University of Kansas program library to plot present value (dollars) versus discount rates. If a price code of 2 is used, subroutines Heading and Writeout are used to summarize the data input and to output price as a function of rate-of-return. Also, subroutine M15A, University of Kansas program library, is used to plot price (dollars) versus rate of return (percent).

CHAPTER 4

MODEL APPLICATION AND RESULTS

This computer model was applied to a general test case that is considered representative of an oil field in Kansas. Input data and output are shown in Appendix F for the economic model results and Appendix G for the micellar slug simulation. Detailed results of the economic model calculations are in Appendix H and summaries of these are shown in Figures 9-14. A total of thirty-nine cases were run for different combinations of the options available in the model. Variations of the simulation model by Shetlar (31) were held to a minimum. The absolute permeability was varied from 499 md to 50 md in different runs. However, economic calculations were performed only for the case of 200 md permeability. All calculation results shown are on an after-tax basis.

Figure 7 gives the results of application of Shetlar's (31) model. It should be kept in mind that the rates are based on a constant pressure drop between injection and production wells. One area of concern was the behavior of the simulation model when water injection began. A constant or lower rate was obtained while remaining at constant pressure. Normally, it would be the expectation

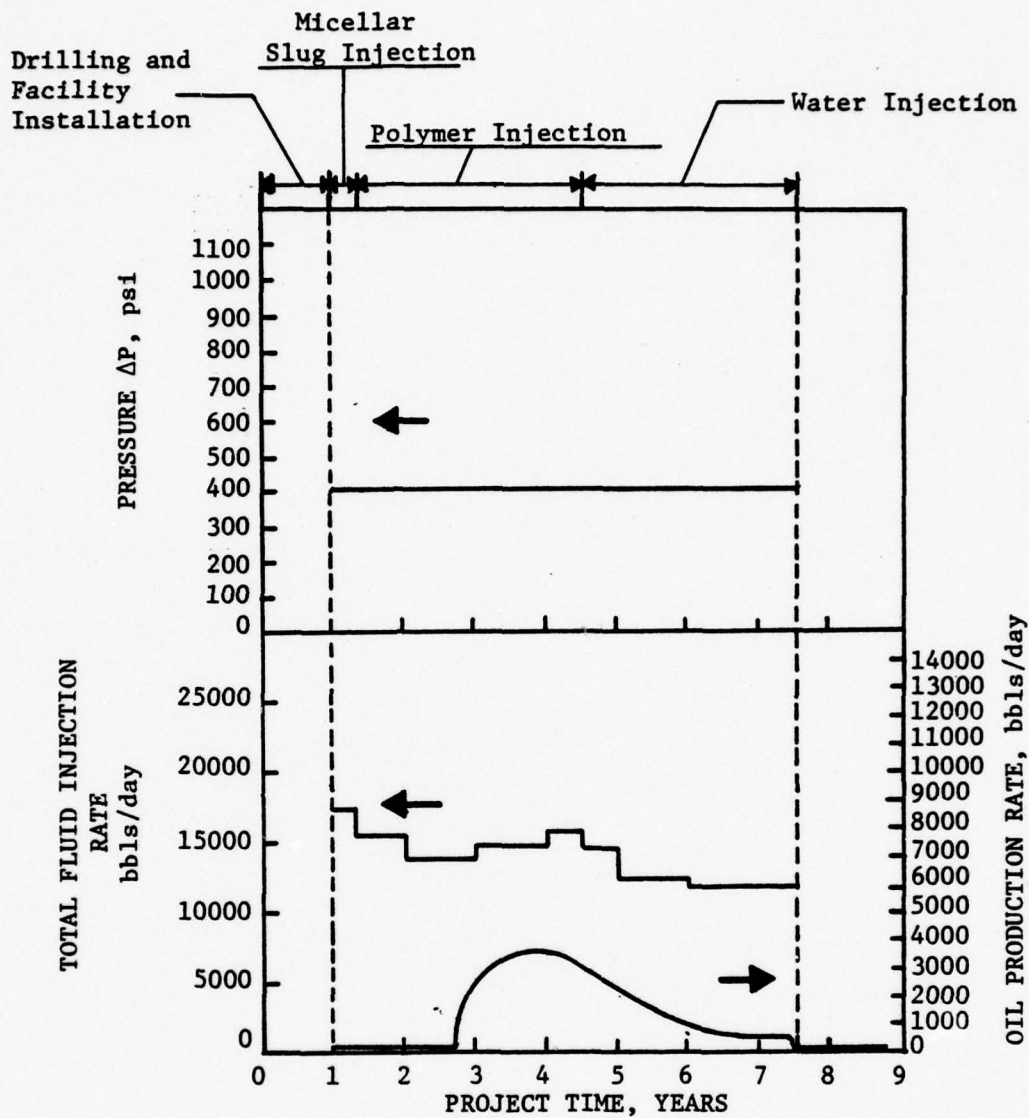


Fig. 7 - Projected Injection and Production Rates at Constant Pressure Drop, 650-Acre Micellar Recovery Project in Kansas

that the water injection rate would increase to maintain a constant pressure. This was not the case and, therefore, it is felt that the simulation model has some fallacies. An effort was not made to determine the problem in the program as the impact on the economics of this error is expected to be minimal.

Figure 8 shows three different production curves which were used as the basis for the economic calculations. Tertiary oil recoveries of 207, 258 and 310 barrels per acre-foot, which correspond to percentage recovery efficiencies of 40%, 50% and 60% respectively, were used to make economic comparisons.

Figure 9 shows the effects on the economic calculation of using different depreciation methods. Figure 9 does indicate that double declining balance depreciation methods have a small advantage over sum-of-the-years digits and straight-line depreciation methods throughout the recovery range. However, for the conditions of the example used here, the differences in rate of return are negligible. In this calculation, chemicals were expensed. If they were capitalized, then the effect of using different depreciation methods would be more pronounced.

The economic model is designed in such a way to allow the user to specify different run conditions. The results of applying some of these different conditions are shown in Figures 10-14. Also, Appendix F provides a layout of

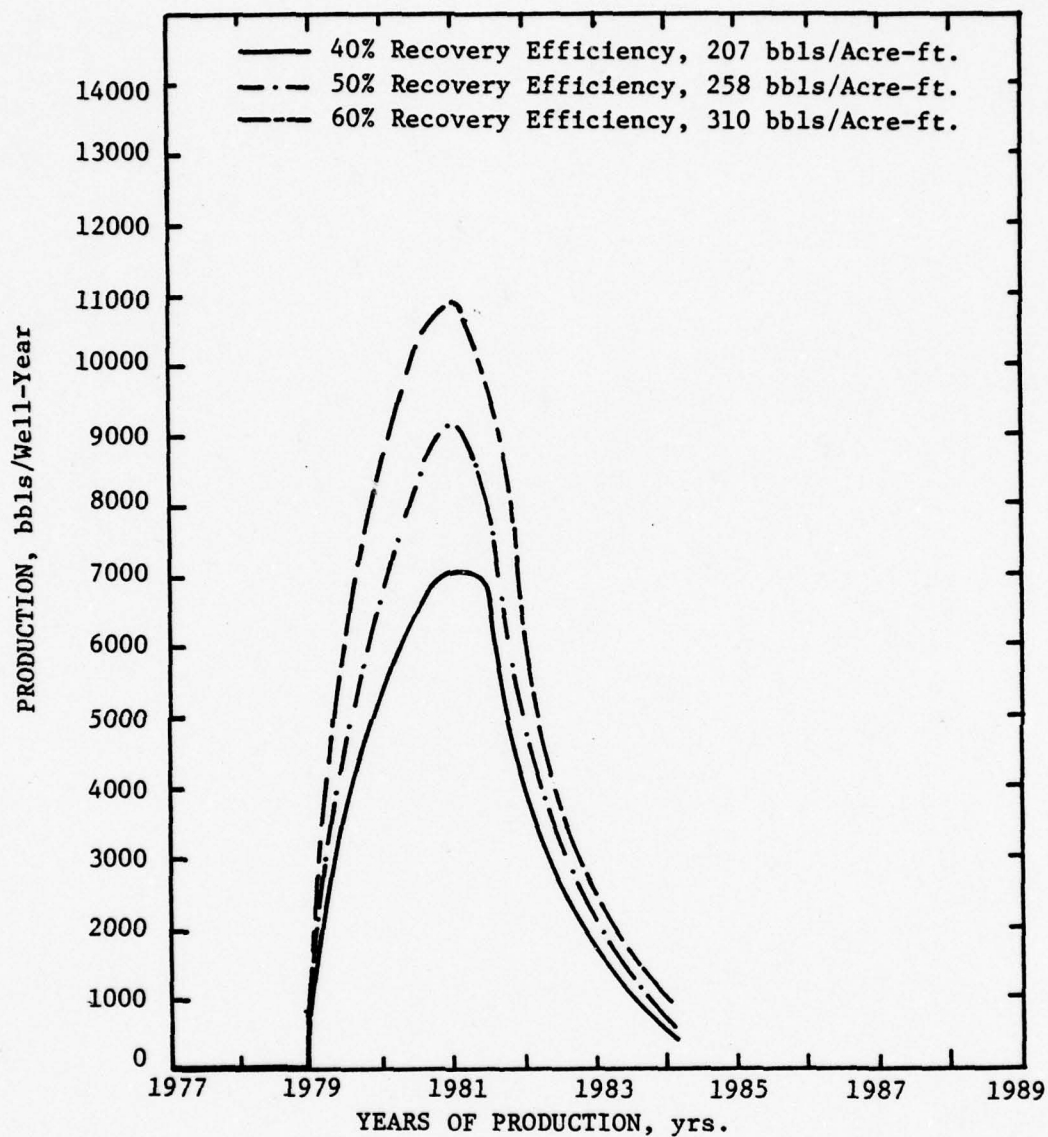


Fig. 8 - Projected Gross Production for Each Well at 40%, 50%, 60% Recovery of Oil in Place After Secondary Recovery

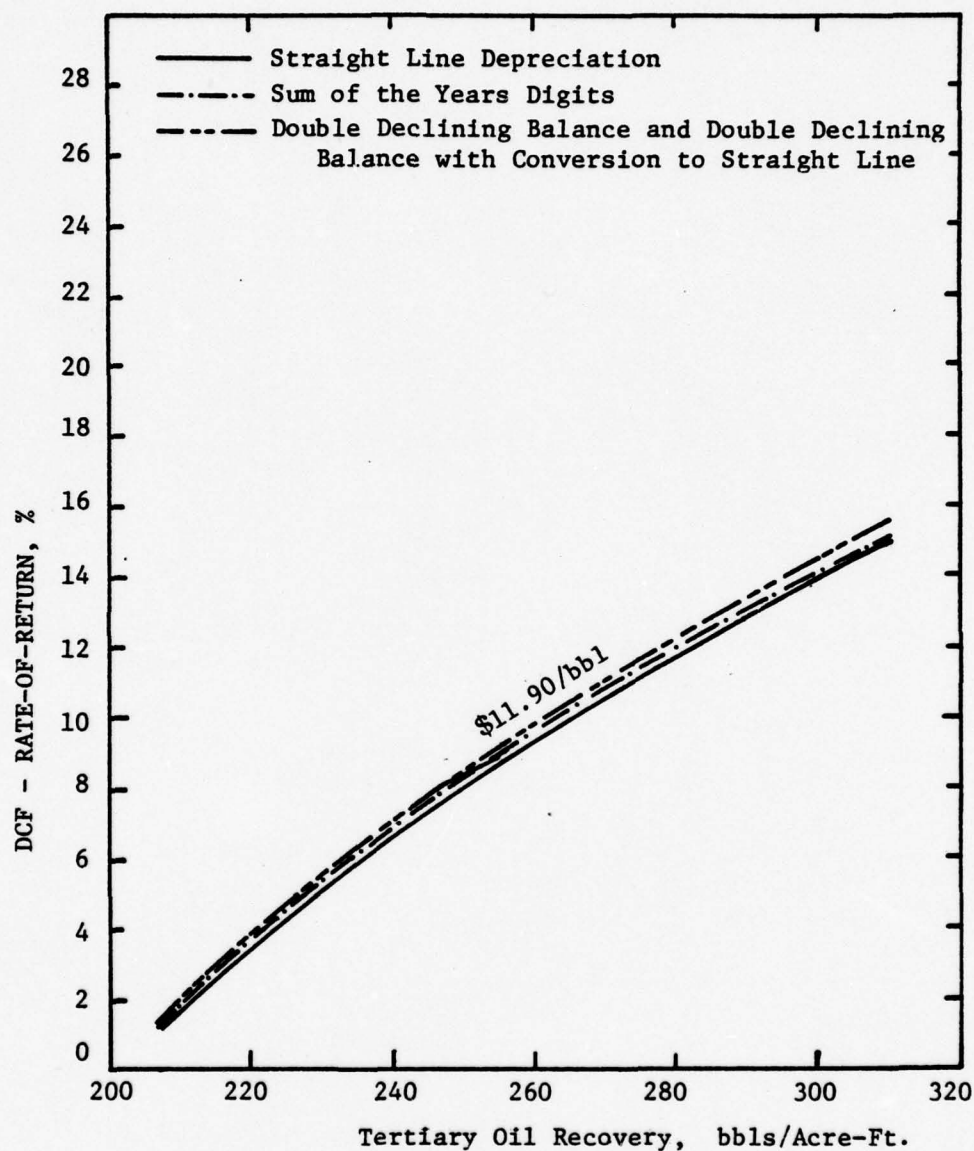


Fig. 9 - Projected Economics for a 650 Acre Micellar Slug Process for an Estimated Development in Kansas. Projections Show Effects After Taxes of Recovery Efficiency and Type of Depreciation.

tabular and graphical output of the program.

Figure 10 shows the effects of handling chemicals as an expensed cost or a capitalized investment at three different oil prices. As an example, under the conditions of expensing of chemicals, an oil price of \$14.00 per barrel and 22% statutory depletion, the recovery would have to be at least 255 barrels per acre-foot to obtain a rate of return of 15 percent. Applying the same conditions, with the exception of capitalization of chemicals, the recovery would have to be well in excess of 300 barrels per acre-foot to obtain the same rate-of-return. Alternatively, at a recovery of 255 barrels per acre-foot the price would have to be approximately \$19.00 per barrel. This confirms Gogarty's (14) conclusion that the economics of the micellar tertiary oil recovery are heavily dependent on the recovery rate and the amount of oil-in-place after water flooding. Figure 11 shows the effects of applying 22% versus 0% statutory depletion allowance. For the case of 15% rate-of-return, chemicals expensed and an oil price of \$14.00 per barrel, the recovery must be 255 barrels per acre-foot. At 0% Statutory depletion allowance, the recovery must be at least 310 barrels per acre-foot.

Figure 12 shows the effects of depletion application but with the chemicals capitalized. For a 15% rate-of-return and a price of oil at \$20.00 per barrel, the recovery must be at least 248 barrels per acre-foot,

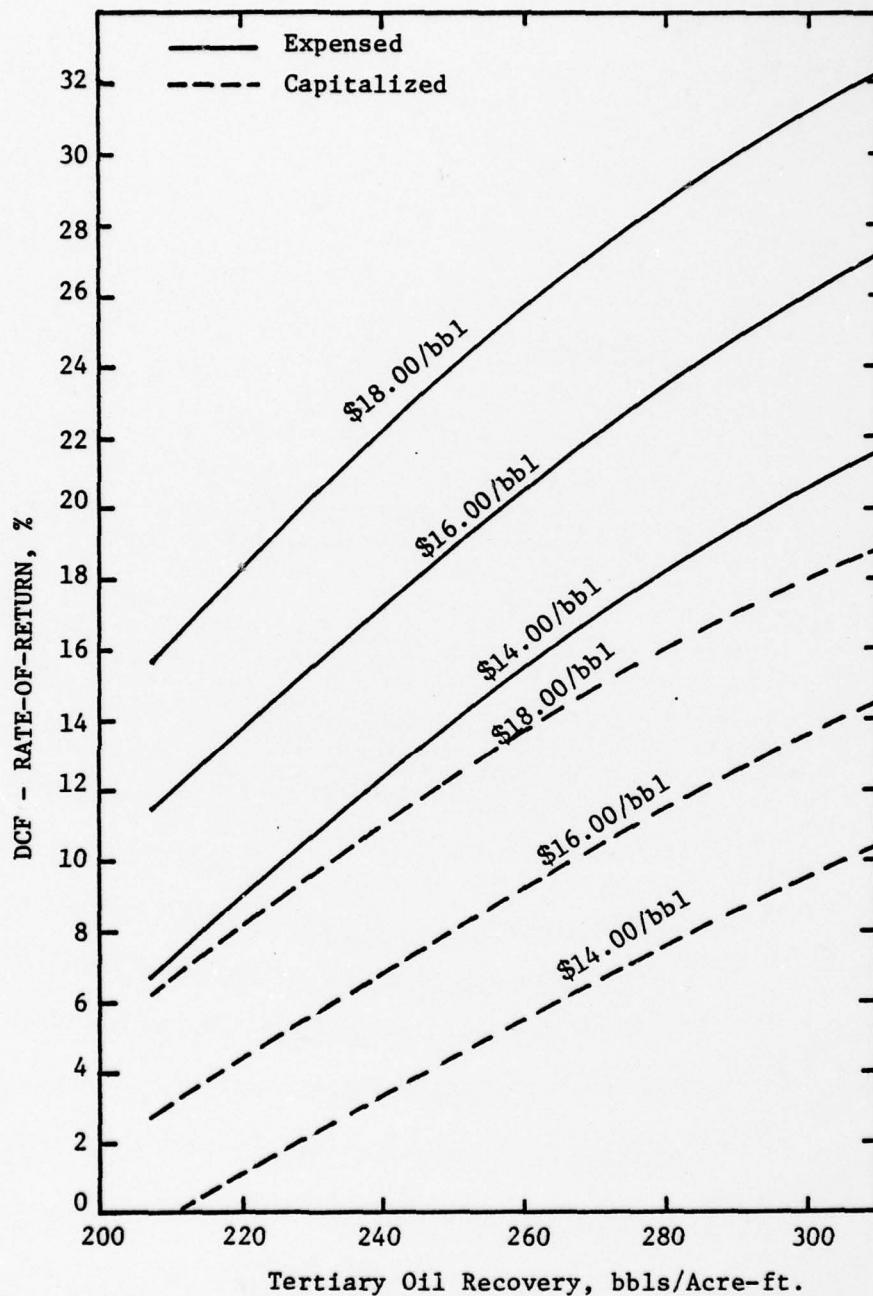


Fig. 10 - Projected Economics for a 650-Acre Micellar Slug Process for an Estimated Development in Kansas. Projections Show Effects After Taxes of Capitalization and Expensing Chemicals at 22% Statutory Depletion

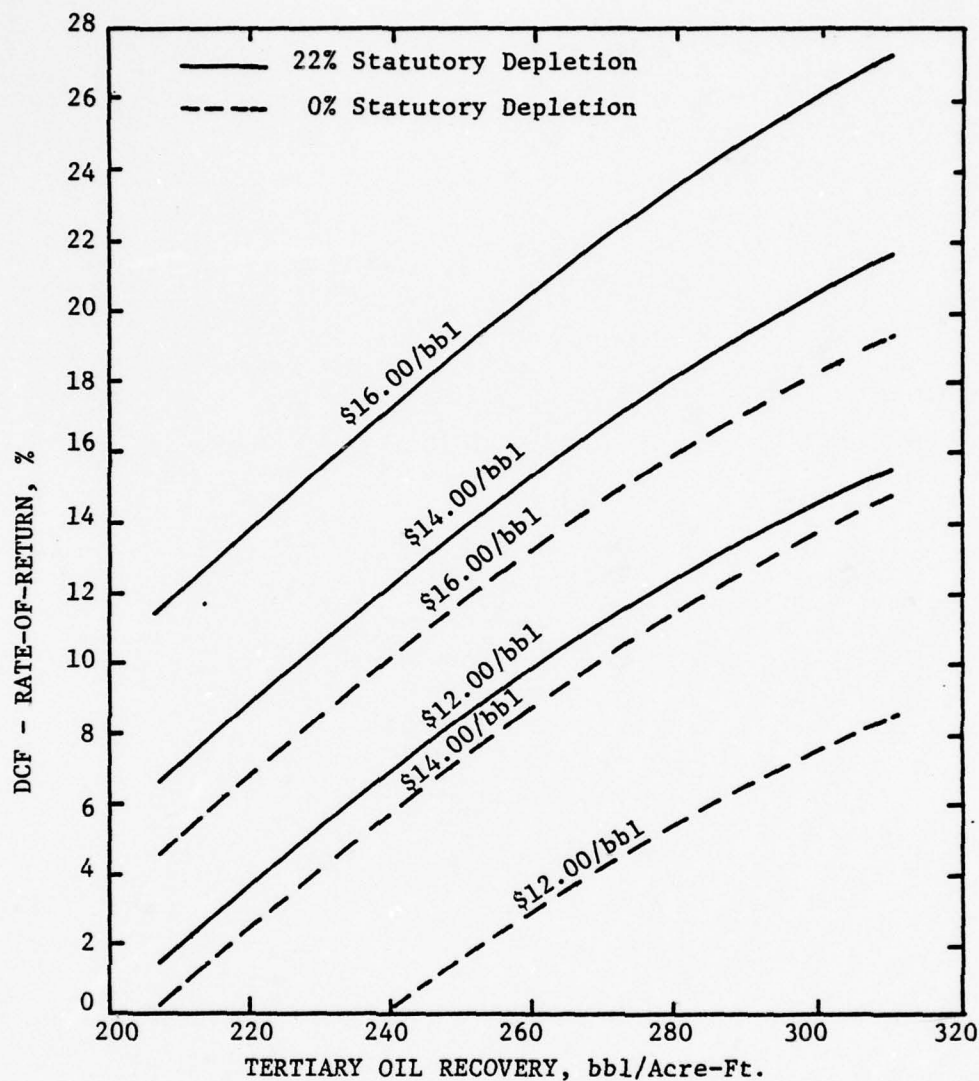


Fig. 11 - Projected Economics for a 650-Acre Micellar Slug Process for an Estimated Development in Kansas. Projections Show the Effects After Taxes of Statutory Depletion While Chemicals Are Expensed.

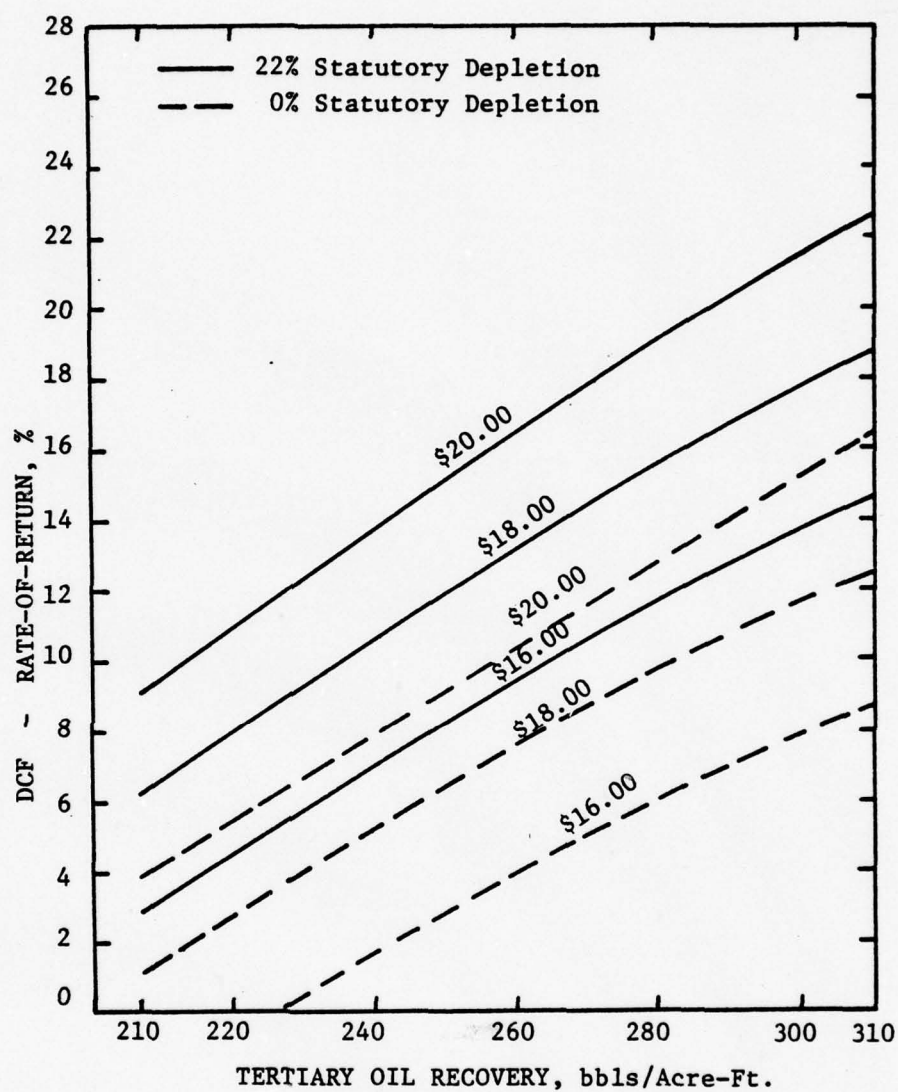


Fig. 12 - Projected Economics for a 650-Acre Micellar Slug Process for an Estimated Development in Kansas. Projections Show the Effects After Taxes of Statutory Depletion While Chemicals are Capitalized.

with 22% statutory depletion and capitalization of chemicals. When 0% statutory depletion allowance is applied under the same conditions of \$20.00/barrel for an oil price, the recovery must be 295 barrels per acre-foot to obtain 15 percent rate-of-return.

Expensing of chemicals is an economic factor that should be seriously considered by the Internal Revenue Service and the United States Congress for micellar tertiary oil recovery processes. Expensing of chemicals would be an important incentive for the investor.

Figures 13 and 14 show price as a function of rate-of-return when chemicals are capitalized or expensed and for 0 and 22 percent statutory depletion respectively. These figures provide a quick view of what the price of oil must be for a given rate-of-return. For example, if a 15 percent rate-of-return is to be realized, when chemicals are expensed, zero % statutory depletion exists and recovery is 258 BBLS/acre-foot, the price per barrel must be \$18.89. On the other hand, if chemicals were capitalized, price would have to be at least \$25.50. This is about a 25 percent increase in price.

The effect on oil price of the statutory depletion allowance is seen in Figure 14. For a 15 percent rate-of-return, with chemicals expensed and a recovery of 258 barrels per acre-foot, a price of \$14.00 per barrel must be realized. This result agrees very well with Gogarty's (14) observations.

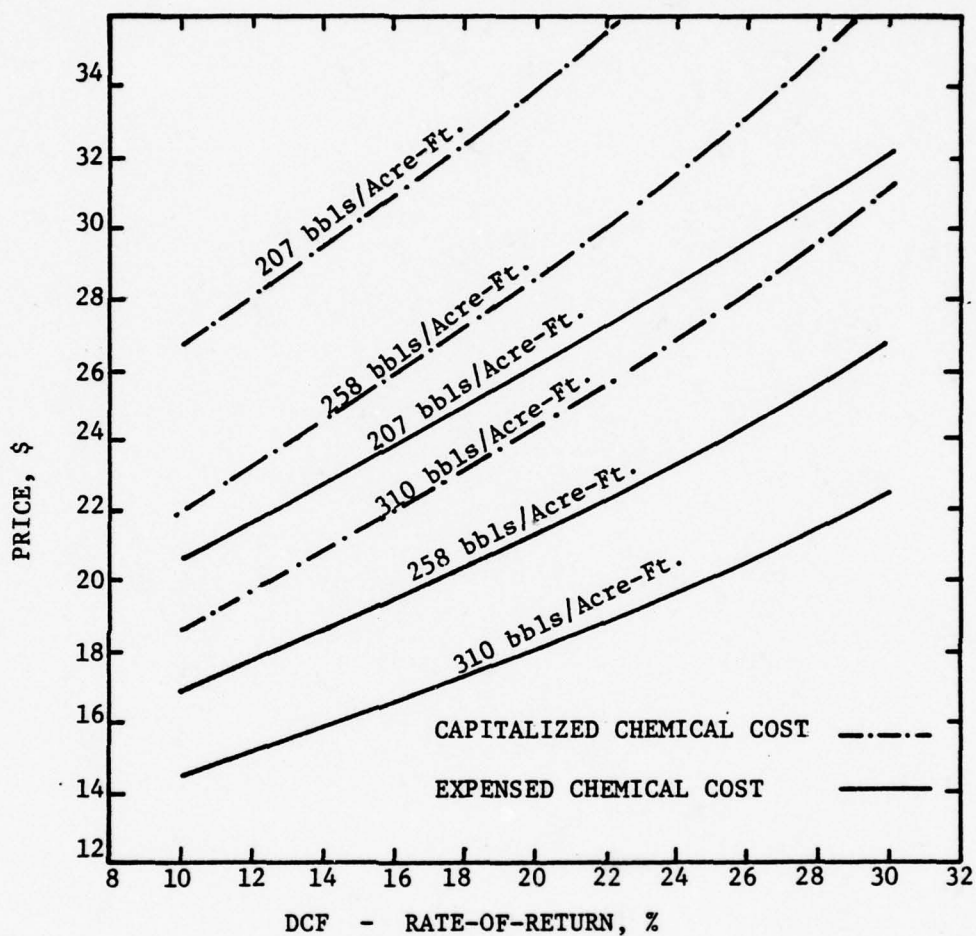


Fig. 13 - Projected Economics for a 650-Acre Micellar Slug Process for an Estimated Development in Kansas. Projections Show the After Taxes Effects of Price as a Function of Rate of Return for Different Production Rates at 0% Statutory Depletion

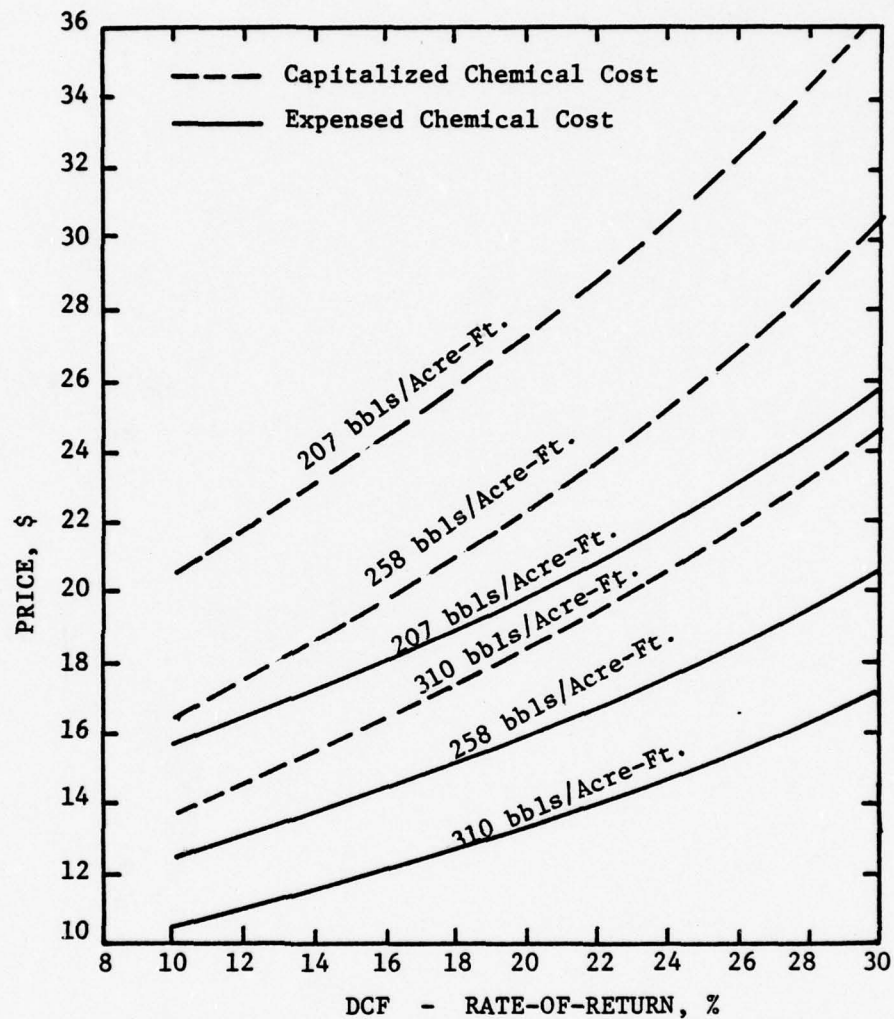


Fig. 14 - Projected Economics For a 650-Acre Micellar Slug Process for an Estimated Development in Kansas. Projections show the after Taxes Effects of Price as a Function of Rate-of-Return for Different Production Rates @ 22% Statutory Depletion.

The economic parameters in this test case were 1975 and 1976 costs with inflation factors applied as necessary (22). It is the author's conception that this test case is only the beginning of an application for this economic computerized model. All costs applied are felt to be representative of current conditions in the oil fields of Kansas. The calculations leave no doubt that for enhanced recovery methods to be utilized in a major way the price per barrel of oil must increase.

If, rather than a total field development, the project were developed on the basis of flooding a few patterns a year, the economics would be affected only in a minor way. This effect would be primarily in connection with initial plant investment which is approximately 10 percent of the total investment for a 5 spot pattern.

Chemicals are a major concern in a micellar/polymer tertiary oil recovery project, because they make up a large percentage of the total investment (about 63% in the example shown here). This is where the risks cause apprehension about the investment in any micellar tertiary oil recovery project. Again, it is felt that the Internal Revenue Service should consider strongly the allowing of chemicals to be expensed and that Congress should consider tax incentives to replace the 22% statutory depletion allowance.

CHAPTER 5

CONCLUSIONS AND RECOMMENDATIONS

The objective of this research was to develop a digital computer model that would perform an economic analysis, based on the discounted-cash-flow, rate-of-return method for the micellar process of tertiary oil recovery. The economic model does not compute oil recovery rates, but assumes that production data will be provided from another source such as another model or field data. The program was designed to perform a discounted-cash-flow rate-of-return calculation and provide results in the form of graphical and tabular output of price versus rate-of-return, summary of cash flow analysis and present value profile. The model is sufficiently flexible, such that with slight modification, other methods of tertiary oil recovery could be analyzed.

The major conclusion of this research lies with the indecision by the Internal Revenue Service to accept the expensing of chemicals for the micellar process of tertiary oil recovery. Capitalization of chemicals with zero percent depletion allowance creates a totally uneconomical investment at present oil prices. A price of \$25.50 per barrel for a recovery of 258 barrels per acre-foot is necessary

to realize a 15 percent rate-of-return for the example studied. Even applying the 22% statutory depletion does not improve the situation to an acceptable investment venture. In this case, the price of oil must be \$18.89 per barrel. Since this is a high risk investment, investors are often going to desire rates of return even higher to offset possible failures. Expensing of chemicals, rather than capitalization, significantly improves the rate-of-return and therefore should be implemented.

Depletion allowance is still an incentive for an investment in enhanced recovery methods of recovery. By application of the 22 percent depletion allowance, discounted-cash-flow, rate-of-return was increased by 10-15 percent for the example studied. Current tax laws limit production to 2000 barrels per day, therefore, it only allows small operators to continue to use depletion allowance and permit income-tax-free replacement in place of extracted production. The problem is that enhanced methods of recovery are based on field development rather than lease development. This automatically eliminates the small operators from obtaining this incentive of 22 percent statutory depletion because recovery rates are a major criteria to economic success when using micellar tertiary oil recovery. Another conclusion relates to depreciation. Even though it is a minor influence, double declining balance with conversion to straight-line is the best way to depreciate a tangible investment.

The last conclusion is that this program provides results that are in good agreement with published data.

It is recommended that some modifications be made in the computer simulation model of the micellar slug process. The data output was not as usable as it might have been. Only one field pattern can be modeled. Therefore, numerous hand calculations had to be performed so that output could be extrapolated to field-wide applications. The model should show cumulative productions and injection output by years as well as days. There is a minor error in the summing of the cumulative values of oil production and toward 100% production, the cumulative values decrease.

A second recommendation would be to utilize the model to run additional example calculations so that a greater sensitivity of the economics to the different parameters could be established.

Finally, the economic model should be "generalized" so that other tertiary oil recovery processes could be analyzed. A method of updating costs should also be incorporated.

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APPENDIX A

DERIVATION OF AN EQUATION TO DETERMINE
PRICE AS A FUNCTION OF RATE OF RETURN

By definition, the first derivative of a straight line equation is the slope of that line. Using the equation

$$y = mx + b \qquad m = \text{Slope} \qquad (A.1)$$

where b is the intercept when $x = 0$ and x is the independent variable and y is the dependent variable.

When a value of the independent variable is provided, the following relation holds (A.2) for determining the independent variable of a straight line equation. After assuming the first value of the dependent variable $y(1)$, then calculate the first corresponding independent variable $x(1)$. If $x(1)$ is larger or smaller than the initial independent variable $x(0)$, an adjustment is made to the first dependent variable ($y(1) \pm 1$) and a second independent variable is calculated.

The third dependent variable is calculated using this equation

$$y(3) = y(1) - \frac{x(1) - x(0)}{x(1) - x(2)} (y(1) - y(2)) \qquad (A.2)$$

Transforming this equation into application of the program variables, the equation is as follows only for cases when KK is equal to 3 or larger and any value of K , this equation is used.

$$\begin{aligned} \text{RRPRICE}(KK) = & \text{RRPRICE}(KK-2) - \left[\frac{\text{RRC}(KK-2) - \text{RRR}(K)}{\text{RRC}(KK-2) - \text{RRC}(KK-1)} \right] \times \\ & [\text{RRPRICE}(KK-2) - \text{RRPRICE}(KK-1)] \end{aligned}$$

Continual iteration on this equation provides a convergence to .10 within six to ten trials.

Other equations used in this program are commonly accepted in the economics field and are not derived.

APPENDIX B

VARIABLES USED IN THE PROGRAM

ADEPLA	A variable name given to the output of the information as to whether allowable depletion is applied to the program and is used in the subroutine Summary output.
ALDEPL	The allowable depletion is determined as the Greater value between PERDEPL and CSTDEPL, \$.
BASIS	The uncapitalized or non-expensed intangible investments remaining at the end of the tax accounting period. (BASIS = TLESHCST - SUMADEPL), \$.
CDEP	The chemical depreciation if the chemicals are capitalized, \$.
CHEM	The chemical code 1) signifies chemicals are expensed 2) signifies chemicals are capitalized
CHEMCOST	The total chemical cost by year and the value is only used when chemicals are capitalized. It is zero if chemicals are expensed, \$.
CHEMCST	The total chemical cost by year and the value is only used when chemicals are expensed. It is zero if chemicals are capitalized, \$.
CHEMI	A variable name given to the output of information as to whether chemicals are capitalized or expensed and is used in the subroutine Summary output.
CSALVAGE	The chemical salvage value at the end of the project, which is zero for present technology, \$.
CSTDEPL	The cost depletion and is a segment of the calculations to determine allowable depletion, \$. (CSTDEPL = BASIS * (PRODSOLD/(RECUNITS + PRODSOLD)))
CUMPW	The cumulative present worth for any particular discount interest rate and becomes a final value by the completion of the life of the project, \$.

$$(CUMPW = \sum_{m=1}^{KLIFE} PW)$$

VARIABLES USED IN THE PROGRAM

ADEPLA	A variable name given to the output of the information as to whether allowable depletion is applied to the program and is used in the subroutine Summary output.
ALDEPL	The allowable depletion is determined as the Greater value between PERDEPL and CSTDEPL, \$.
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CDEP	The chemical depreciation if the chemicals are capitalized, \$.
CHEM	The chemical code 1) signifies chemicals are expensed 2) signifies chemicals are capitalized
CHEMCOST	The total chemical cost by year and the value is only used when chemicals are capitalized. It is zero if chemicals are expensed, \$.
CHEMCST	The total chemical cost by year and the value is only used when chemicals are expensed. It is zero if chemicals are capitalized, \$.
CHEMI	A variable name given to the output of information as to whether chemicals are capitalized or expensed and is used in the subroutine Summary output.
CSALVAGE	The chemical salvage value at the end of the project, which is zero for present technology, \$.
CSTDEPL	The cost depletion and is a segment of the calculations to determine allowable depletion, \$. (CSTDEPL = BASIS * (PRODSOLD/(RECUNITS + PRODSOLD)))
CUMPW	The cumulative present worth for any particular discount interest rate and becomes a final value by the completion of the life of the project, \$.

$$(CUMPW = \sum_{m=1}^{KLIFE} PW)$$

DCF	The discount factor and is used to determine the present worth of the net cash flow. It is calculated using a single payment present worth factor for a particular interest rate. $(DCF = 1. / (1. + INTEREST / 100) ** M)$
DDB	The subroutine Double Declining Balance for Calculating depreciation.
DDBSL	The subroutine Double Declining Balance for calculating depreciation.
DEPCODE	The depreciation code and is a switch used to select a method of depreciation. <ol style="list-style-type: none"> 1) Straight Line Depreciation 2) Sum of the Years Digits 3) Double Declining Balance 4) Double Declining Balance with conversion to Straight Line.
DEPLCODE	Depletion code and is a switch used to select whether allowable depletion should be applied. <ol style="list-style-type: none"> 1) Calculate an allowable depletion. 2) Disregards a depletion calculation. Therefore, allowable depletion is zero.
DEPRSHUN	The sum of the depreciations for any particular tax accounting year during the life of the project. It may be calculated for the different DEPCODE's, \$.
DIF	The difference between the calculated rate of return and the read-in rate of return $(DIF = RRC - RRR)$.
DIFF	The difference between the absolute values of the cumulative present worths that have different signs in any succeeding year. $(DIFF = ABS (CUMPW (L)) + ABS (CUMPW (L-1)))$.
DIFF	A variable name given to the difference in the tangible investment (TANGI) and the depreciated value to date and is used in subroutines DDB and DDBSL.
DIFFER	A variable name given to the difference between percentage depletion (PERDEPL) and cost depletion CSTDEPL.
EORECOV	The estimated oil recovery during the life of the project and is used in calculating cost depletion, BBLS.

EXPENCST	The investments that can be expensed and it is the sum of the lifting cost (LIFTCST), Intangibles (INTANG), general and administrative costs, (GACST), and chemicals if expensed (CHEMCST), \$ (EXPENCST = LIFTCST + INTANG + GACST + CHEMCST).
FEDTAXIN	The federal taxable income and is that income on which taxes must be paid to the federal government, \$ (FEDTAXIN = NIBFSIT - ALDEPL - STITAX).
FEDINTAX	The federal income tax that is obtained by using a tax factor of 48 percent for this program times the federal taxable income (FEDTAXIN), \$.
FIELD	A variable name given to the field from which production is being analyzed.
GACST	The general and administrative cost and are those costs of management not directly related to this project. Normally, a small percentage of the cost, but a very important element, \$.
GIBTDD	The gross income before federal and state taxes, depletion, or depreciation, \$. (GIBTDD = GINCOME - EXPENCST).
GINCOME	The gross income from the sale of the working interest or net oil production (NOPROD), \$. PRICECD = (1) GINCOME = PRICE * NOPROD PRICECD = (2) GINCOME = RRPRICE * NOPROD
GOPROD	The gross oil production and is an input value determined from a computer simulation of the field by year, BBLs/YEAR.
GOPRODTC	The gross oil production treating cost and is applied when production of micellar or polymer solution occurs, \$/BBL.
INTANG	The intangible investments, which are those investments that have no salvage value, \$.
INTEREST	The interest rate used to calculate discount factors (DCF), %. (5, 10, 15, 20, 25, 30, 35, 40, 45, and 50 percent).
KINTREST	Equal to interest rate and is used to transfer data into the plot routine M15A without affecting interest, %.

KLIFE	Equals project life (PLIFE), but is an integer variable, years.
LABEL	The label information data for the plot subroutine M15A.
LEASHCST	The leasehold cost and includes options and bonuses, purchase price, lease expense, surveys, title and other legal fees, rental (First year's and delays) and exploration costs (geological, geophysical and exploration drilling), \$.
LIFE	The depreciable life of the tangible investments, years.
L*5	The depreciable group lives of 5, 10, 15, 20, 25 years, years.
LIFTCST	The lifting cost which includes power, operating and production cost and repair, \$.
LIFTFACT	The lifting factor is a cost value applied to the total barrels of fluid produced, \$/BBL.
LOC	A variable name given to the location of the field of study and is used in the subroutine Summary output.
M15A	A subroutine that is used to perform plotting routines and it is maintained in the program library of the University of Kansas.
MICELCST	The cost of the micellar solution used to inject into the formation. It is priced at a cost per barrel, \$/BBL.
MICELIJC	The micellar injection costs are costs for injecting the micellar solution, \$/BBL
MICELPROD	The micellar production that is produced at the wells, BBLs
MICELQTY	The quantity of micellar solution injected into the formation but purchased in a tax accounting year. This purchase can be done in bulk or as the project progresses during the micellar injection period, BBLs.
MSUM	A variable name for a counter used in the depreciation subroutine SYOD.

N	The number of years that data will be calculated, years. ($N = \text{PLIFE} + 1$).
NN	The remaining number of depreciable years in the life of a group of equipment, years.
NDEPI	The net depletable income and is used in calculating percent depletion, \$. ($\text{NDEPI} = .65 * \text{NIBFSIT}$)
NETCASHF	The net cash flow during a project, \$. ($\text{NETCASHF} = \text{GINCOME} - \text{EXPENCST} - \text{LEASHCST} - \text{TTICST} - \text{STITAX} - \text{FEDINTAX}$).
NIBFSIT	The net income before federal and state income tax, \$. ($\text{NIBFSIT} = \text{GIBTDD} - \text{DEPRSHUN}$)
NIJW	The number of injection wells. This is information for the subroutine Summary.
NOPROD	The net oil production, BBLs/YEAR. ($\text{NOPROD} = 7/8 * \text{GOPROD}$).
NPROD	The number of production wells. This is information for the subroutine Summary.
OUTPUT	The subroutine output that is used to print out the headings used in present worth profile summary calculations.
PATTERN	A variable name used to designate the type of drilling pattern that would be used, spot.
PERCENTG	The percentage of gross income and is used in calculating percent depletion, \$. ($\text{PERCENTG} = .22 * \text{GINCOME}$).
PERDEPL	The percent depletion and is calculated on the basis of the lessor of 22% of gross income (PERCENTG) and the net income before federal and state income tax times .65% (NDEPI), \$.
PERDEPLL	A variable name given to the difference between the net depletable income and the 22% of gross income. It is used to determine the algebraic sign of the results, \$.
PLIFE	The number of years that the project is considered feasible under economic evaluations and estimates. It is used as KLIFE for integer purposes, years.

POLYMCST	The cost of polymer per pound converted into concentration for a barrel of water. Therefore, a cost per barrel is read into the program, \$/BBL.
POLYMIJC	This is the cost to inject polymer solution into the injection wells, \$/BBL.
POLYMPRD	The polymer production is that fluid related to polymer that is produced from the production wells, BBLs.
POLYMQTY	The polymer quantity that is injected into the field for mobility control, but purchased prior to injection or as the injection is occurring, BBLs.
PRICE	Price of the current sale of new oil, \$.
PRICECD	<p>The price code and is used to cause a switch from straight calculation of rate of return to determination of price as a function of rate of return.</p> <ol style="list-style-type: none">1) Perform the calculations with a read-in price.2) Perform the calculations by reading a rate of return assuming a price, checking the match of rate of returns (calculated and read-in values) and adjustment of price. This continues until a tolerance of .10 is met or no convergence.
PRODOH	The production on hand and not sold during a tax accounting year. For this program, this value is considered ZERO, BBLs.
PRODSAND	A variable name given to the producing sand and is used in the subroutine Summary output.
PRODSOLD	The production sold during a tax accounting year and is used in calculating cost depletion, BBLs (PRODSOLD = GOPROD - PRODOH).
PVALUE	A variable name used to convert CUMPW into a unidimensional array and is used in the subroutine M15A to plot, \$. (CUMPW versus discount rate).
PW	The present worth, which is the value now of a sum of money which is payable with interest at some future date, \$. (PW = NETCASHF * DCF).

RECUNITS	The recoverable units of oil remaining at the end of the accounting period and is used in calculating cost depletion, $BBLs (RECUNITS + EORECOV - SUMGOP)$.
RIPRICE	The variable name given to the calculated price as a function of rate of return and is used in subroutine riteout, \$.
RR	The rate of return, sometimes referred to as discounted cash flow rate, is the maximum interest rate which could be paid on borrowed capital and still break even. If you can invest money at amounts greater than this percent, you would be better off to take such an investment.
RRC	A variable name given to a calculated rate of return when price is determined as a function of rate of return, %.
RRPRICE	A variable name used to calculate a price (RRPRICE) versus a read-in rate of return, \$.
RRR	A variable name given to the read-in value of the rate of return in the calculation of price (RRPRICE) as a function of rate of return, %.
SALDEPL	The variable name used to sum the allowable depletion, \$.
SCHECST	The variable name used to sum the expensed chemical costs, \$.
SCHEMCST	The variable name used to sum the capitalized chemical costs, \$.
SCSTDEPL	The variable name used to sum the cost depletion, \$.
SDEPSHUN	The variable name used to sum the depreciation, \$.
SEXPECST	The variable name used to sum the expense costs, \$.
SFEDITAX	The variable name used to sum the federal income tax, \$.
SFEDTAXI	The variable name used to sum the federal taxable income, \$.
SGACST	The variable name used to sum the general and administrative costs, \$.

SGIBTDD	The variable name used to sum the gross income before taxes, depletion and depreciation, \$.
SGINCOME	The variable name used to sum the gross income, \$.
SGOPROD	The variable name used to sum the gross oil production, BBLs.
SINTANG	The variable name used to sum the intangible costs, \$.
SIZE	The size of the field being evaluated and is used in the subroutine Summary output, acres.
SLD	The subroutine Straight Line Depreciation method used to calculate depreciation.
SLESHCST	The variable name used to sum the leasehold costs, \$.
SLIFTCST	The variable name used to sum the lifting costs, \$.
SNCF	The variable name used to sum the net cash flows for the project life, \$.
SNDEPI	The variable name used to sum the net depletable income, \$.
SNIBFSIT	The variable name used to sum the net income before federal and state income taxes, \$.
SNOPROD	The variable name used to sum the net oil production, BBL.
SPACE	A variable name used to designate the spacing used to layout the field, acre.
SPERCETG	The variable name used to sum the percentage of gross income, \$.
SPERDEPL	The variable name used to sum the percent depletion, \$.
SSTAMOTS	The variable name used to sum the state amortization of tangible assets, \$.
SSTITAX	The variable name used to sum the state income tax, \$.
STAMORTS	The sum of the state amortization for any one tax accounting period, \$.
STAMORTZ	The state amortization for any tangible investment over a 24 month period, \$.

STANGIBL	The variable name used to sum the tangible investments, \$.
STAXINC	The variable name used to sum the taxable income, \$.
STDEP	The variable name used to sum tangible depreciation in a particular group depreciable life, \$.
STITAX	<p>The state income tax is calculated as a percent factor times the taxable income minus the amortization of tangible equipment over a 24 month period, \$.</p> <p>\$25,000 or less 4.5%</p> <p>\$25,001 or more 6.75%</p> <p>(STITAX = \$FACTOR * TAXINC)</p>
STITCST	The variable name used to sum the total tangible costs, \$.
STSALVAG	The sum of the salvage value that is the undepreciated investment after the life of the project is reached, \$.
SUM	A variable name used to designate the value of the sum of the years digits of the depreciable life, \$.
SUMADPL	<p>The sum of the allowable depletion up to and including the tax accounting period. It is used in the calculation of cost depletion (CSTDEPL), \$.</p> <p>(Note - for the first year, it is ZERO)</p>
SUMDEP	A variable name given to the sum of the tangible depreciation in all of the depreciation subroutines, SLD, SYOD, DDB, and DDBSL, \$.
SUMGOP	The sum of the gross oil produced during the life of the project and is used in calculating cost depletion (CSTDEPL), \$.
SUMM	A variable name given to the sum of the previous year's chemical depreciation (if capitalized) and is used in subroutines DDB and DDBSL, \$.
SUMMARY	A subroutine used to output the parameter information defining the particular economic program run.
SYOD	The subroutine Sum of the Year's Digits and is used to calculate depreciation.
TANGI	The tangible investments having depreciable lives of 5, 10, 15, 20, and 25 years, \$.

TANGIBLE

The sum of the tangible investments in any year no matter what the depreciable life, \$.

$$(TANGIBLE = \sum_{M=1}^{KLIFE} (TANGI(M,1) + TANGI(M,2)$$

$$+ TANGI(M,3) + TANGI(M,4) + TANGI(M,5).$$

TAXINC

The taxable income and is calculated by the equation, \$.

$$(TAXINC = NIBFSIT - STAMORTS).$$

TDEP

The tangible depreciation and is calculated by the following equations depending on the method of depreciation selected, \$.

$$(SLD: TDEP = TANGI/L*5.)$$

$$(SYOD: TDEP = TANGI*(LIFE-NN)/SWM)$$

$$(DDB: TDEP = DIFF * 2.00/L*5.)$$

(DDBSL: Same as DDB but converts to straight line when DDB is smaller in value in an accounting period.)

TDEPR

A variable name used to designate the type of depreciation that is applied in the program and is used in the output of subroutine Summary.

TLESHCST

The total leasehold cost up to and including the tax accounting period and is used in calculating cost depletion, \$.

TODM

A variable name used in the output of the percentage by pore volume of micellar solution. It is used in the subroutine Summary output.

TODP

A variable name used in the output of the percentage by pore volume of polymer. It is used in the subroutine Summary output.

TTICST

The total tangible investment cost and is calculated by the following equation, \$.

$$(TTICST = TANGIBLE + CHEMCOST - STSALVAG)$$

Note: Salvage is only included in the last year of the project.

WATERDC

The water disposal costs are those costs for disposing of produced water, \$,BBL.

WATERIC

The water injection costs are those costs for injecting water in the injection wells, \$,BBL.

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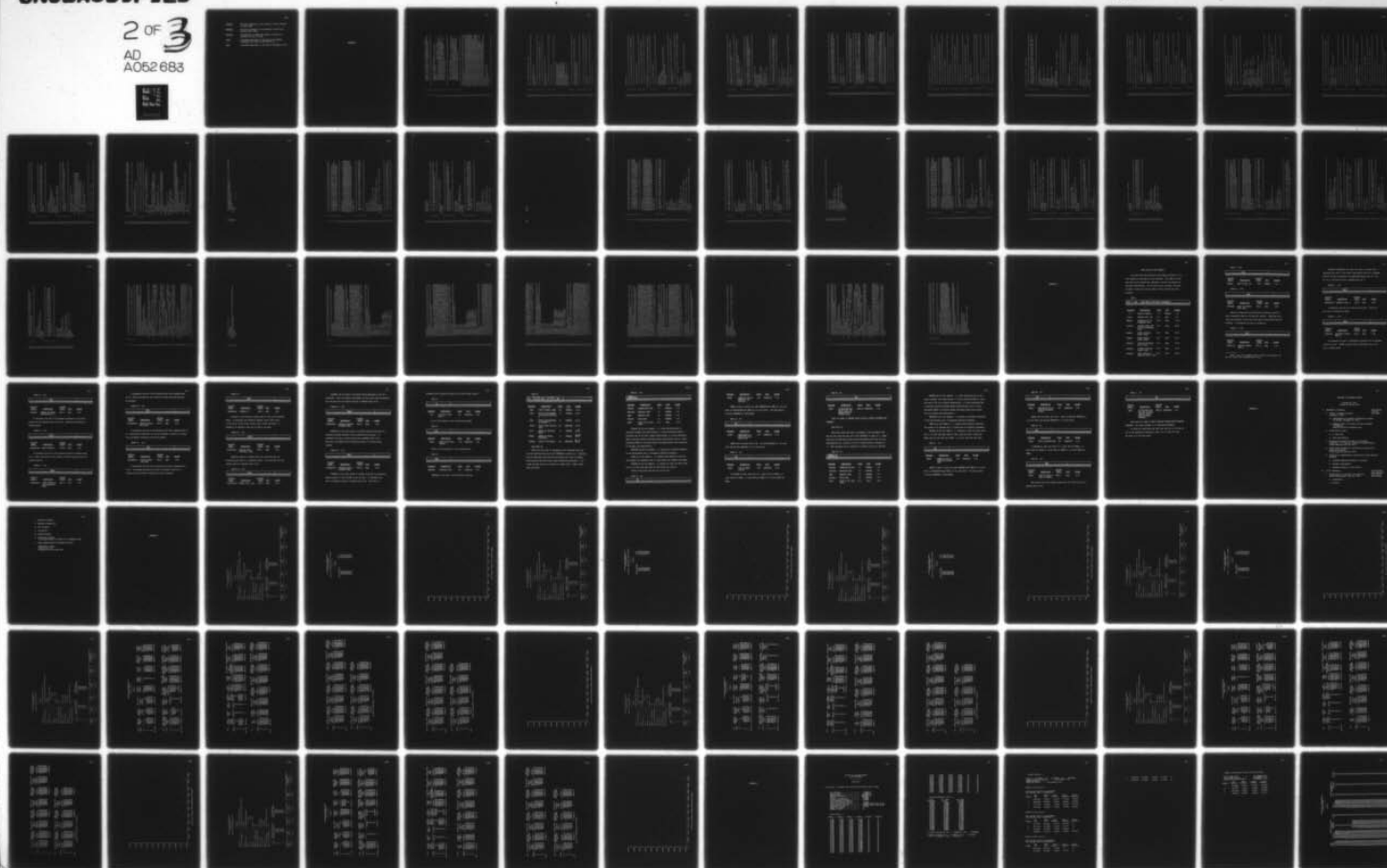
KANSAS UNIV LAWRENCE DEPT OF CHEMICAL AND PETROLEUM--ETC F/G 8/9
DEVELOPMENT AND APPLICATION OF A COMPUTERIZED ECONOMIC MODEL FO--ETC(U)
1976 6 N PLOCEK

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NL



WATERINJ	The water injection is the quantity of water injected by year, BBLS.
WATERPRD	The water production is the quantity of water produced by year, BBLS.
WRITEOUT	A subroutine to output the results of price as a function of rate of return.
YCDEP	A variable name given to the sum of the chemical depreciation if they are capitalized, \$.
YEAR	A variable name given to the year of investment, year.

APPENDIX C

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PROGRAM FOR CALCULATING THE DISCOUNTED CASH FLOW RATE OF
RETURN OF THE MICELLAR METHOD OF TERTIARY OIL RECOVERY AND
GIVEN A RATE OF RETURN --- DETERMINE THE OIL PRICE.

*****

TERTIARY OIL RECOVERY PROJECT
DEPARTMENT OF CHEMICAL AND PETROLEUM ENGINEERING
UNIVERSITY OF KANSAS
1/7/76
MAJOR GEORGE N. PLOCEK

THIS PROGRAM SIMULATES THE CASH FLOW FOR THE DEVELOPMENT OF
A PETROLEUM RESERVOIR UNDERGOING A MICELLAR-POLYMER
TERTIARY RECOVERY PROCESS. THIS PROGRAM REQUIRES INPUT OF
THE PROJECTED GROSS OIL PRODUCTION AND QUANTITY OF
CHEMICALS REQUIRED DURING THE LIFE OF THE PROJECT. ALSO
COST DATA MUST BE PROVIDED.

*****

BEGIN EXECUTABLE STATEMENTS
READ IN HEADING INFORMATION TO DEFINE THE NUMBER OF PRODUC-
TION WELLS, INJECTION WELLS, SIZE OF THE FIELD, METHOD
OF DEPRECIATION, WHETHER CHEMICALS ARE CAPITALIZED OR
EXPENSED, APPLICATION OF DEPLETION ALLOWANCE, OIL PRICE,
AND DETERMINATION OF OIL PRICE AS A FUNCTION OF RATE OF
RETURN OVER A RANGE OF DISCOUNT RATES.

*****

CHARACTER LOC*30, FIELD*30, PRODSAND*30, CHEMI*30, ADEPLA*30, IDEPR*30,
1SPACE*11, PATTERN*11
COMMON TANGI(26,5), CHEMCOST(26), DEPRSHUN(26), PLIFE, STSALVAG, TDEP(2
16,5,26), CDEP(26,26), YCDEP(26), YEAR(26), GOPROD(26), LEASHCST(26), INT
2ANG(26), GACST(26), LIFTCT(26), TANGIBLE(26), CHEMCST(26), RRR(10), RRP
3RICE(10), EXPENCST(26), NOPROD(26), GINCOME(26), GIBIDD(26), TITCST(26)
4, NINFSIT(26), PERDEPL(26), CSTDEPL(26), ALDEPL(26), NDEPI(26), PERCENTG
5(26), STAMORTS(26), TAXINC(26), STITAX(26), FEDTAXIN(26), FEDINTAX(26),
6NETCASHF(26), DCF(10,26), PWC(10,26), CUMPRW(10,26), RPKLIFE, SNCF
7DIMENSION INTERST(11), MICELQTY(26), POLYQTY(26), RECUNITS(26), SUMA
8IDPL(26), TLESHST(26), STAMORTZ(26), RRC(10), PVALUE(11), LABEL(14), SUM
92GDP(26), KINTREST(11), RPRICE(12), MICELCST(26), POLYMCST(26), WATERIN
10J(26), WATERPRD(26), MICELPRD(26), POLYMPRD(26), FLUIDFLW(26)
11REAL LEASHCST, INTANG, LIFTCT, MICELQTY, MICELCST, NOPROD, NDEPI, NETCAS
12THF, INTEREST, NINFSIT, KINTREST, LIFTFACT, MICELJJC, MICELPRD
13INTEGER SIZE, TOPM, TOPP, DEPCODE, DEPLCODE, CHEM, PRICECD, YEAR
14READ(5,1) N, PLIFE, FORECOV, LIFTFACT, WATERIC, WATEROC, MICELJJC, POLYMI
15JJC, GOPRODTC
161 FORMAT(12,F5.2,F12.2,F6.3)
17READ(5,11)(YEAR(M), M=1,N-1)
1811 FORMAT(20I2)
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53 C
54 C READ IN: GROSS OIL PRODUCTION BY YEAR.
55 C *****
56 C
57 C
58 C READ(5,2)(GOPROD(M),M=1,N-1)
59 C 2 FORMAT(5F12.2)
60 C
61 C *****
62 C
63 C READ IN TANGIBLE COST DATA BY YEAR AND DEPRECIABLE LIFE.
64 C *****
65 C
66 C
67 C READ(5,3)((TANGI(J,L),L=1,5),J=1,N-1)
68 C 3 FORMAT(5F11.2)
69 C
70 C *****
71 C
72 C READ IN EXPENSE COST DATA.
73 C *****
74 C
75 C
76 C READ(5,4)(LEASHCST(M),M=1,N-1)
77 C READ(5,4)(INTANG(M),M=1,N-1)
78 C READ(5,4)(GACST(M),M=1,N-1)
79 C READ(5,4)(WATERINJ(M),M=1,N-1)
80 C READ(5,4)(WATERPRD(M),M=1,N-1)
81 C READ(5,4)(MICELPRD(H),M=1,N-1)
82 C READ(5,4)(POLYMPRD(M),M=1,N-1)
83 C 4 FORMAT(6F10.2)
84 C READ(5,5)(INTEREST(M),M=1,10)
85 C 5 FORMAT(10F6.3)
86 C
87 C *****
88 C
89 C
90 C READ IN POLYMER COST AND MICELLAR COST PER BARREL INJECTED.
91 C READ(5,5)(MICELCST(H),M=1,N-1)
92 C READ(5,5)(POLYMCST(M),M=1,N-1)
93 C *****
94 C
95 C *****
96 C
97 C *****
98 C
99 C READ IN THE AMOUNT OF MICELLAR SOLUTION PURCHASED BY YEAR FOR
100 C INJECTION.
101 C *****
102 C
103 C READ(5,6)(MICELQTY(M),M=1,N-1)
104 C

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155 C
156 C

6 FORMAT(5F12.2)
*****
READ IN THE AMOUNT OF POLYMER PURCHASED BY YEAR FOR INJECTION.
*****
READ(5,6)(POLYMTY(M),M=1,N-1)
*****
CALCULATE THE TOTAL FLUID FLOWING IN AND OUT OF THE WELLS.
*****
DO 99 LI=1,N-1
99 FLUIDFLW(LI) = WATERPRD(LI)+MICELPRD(LI)+POLYMPRD(LI)+GOPROD(LI)
*****
READ IN SUMMARY INFORMATION
*****
READ(5,7) LOC
7 FORMAT(A30)
READ(5,7) FIELD
READ(5,7) PRODSAND
READ(5,8) SIZE,TODM,TODP,SPACE,NIJW,NPROD,Pattern
8 FORMAT(I10,2I2,A11,2I4,A11)
DO 10 J=1,N-1
*****
SUM THE TOTAL INVESTMENT IN ANY ONE YEAR NO MATTER WHAT THE
DEPRECIABLE LIFE.
*****
TANGIBLE(J) = TANGI(J,1)+TANGI(J,2)+TANGI(J,3)+TANGI(J,4)+TANGI(J,
15)
10 CONTINUE
RR = 0.0
SMCF = 0.0
100 READ(5,2,END=700) DEPCODE,DEPLCODE,CHEM,PRICECD,PRICE
9 FORMAT(4I2,F5.2)
READ(5,7) CHEM
READ(5,7) ADEPLA
READ(5,7) TDEPR
DO 20 M=1,N-1

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157 C *****
158 C
159 C CALCULATE THE CHEMICAL COST FOR THE QUANTITY OF CHEMICALS
160 C PURCHASED IN ANY YEAR OF THE PROJECT.
161 C
162 C *****
163 C
164 C CHEMCST(M) = POLYMCST(M)*POLYMCST(M)+MICELCST(M)*MICELCST(M)
165 C IF(CHEM.GT.1) CHEMCST(M) = CHEMCST(M)
166 C IF(CHEM.LE.1) CHEMCST(M) = 0.0
167 C 20 CONTINUE
168 C IF(PRICECD.EQ.1) GO TO 35
169 C *****
170 C
171 C PRICE CODE EQUALS 2 -- THE RATE OF RETURNS ARE READ IN SO THAT
172 C RRPRICE (PRICE) CAN BE DETERMINED ON AN ITERATIVE BASIS9 IF IT
173 C IS PRICE CODE EQUAL 1 THIS SECTION IS BYPASSED.
174 C *****
175 C
176 C *****
177 C
178 C READ(5,24)(RRR(K),K=1,10)
179 C 34 FORMAT(10F5.2)
180 C 35 DO 203 K=1,10
181 C 40 DO 202 KK=1,50
182 C IF(PRICECD.LE.1) GO TO 65
183 C IF(PRICECD.GT.1) GO TO 45
184 C GO TO 65
185 C 45 IF(KK.LE.1) GO TO 50
186 C RRC(KK-1) = RR
187 C DIF = RRC(KK-1) - RRR(K)
188 C GO TO 51
189 C *****
190 C
191 C AN ASSUMED PRICE OF $20.00 IS USED TO START THE CALCULATIONS. IT
192 C REQUIRES TWO CALCULATIONS TO BEGAN A DIRECTION OF CONVERGENCE.
193 C *****
194 C
195 C *****
196 C
197 C 50 RRPRICE(KK) = 20.00
198 C GO TO 65
199 C 51 IF(ABS(DIF).LE.0.10) GO TO 52
200 C IF(KK.GE.10) GO TO 61
201 C IF(KK.GE.3) GO TO 60
202 C GO TO 54
203 C 61 WRITE(6,62) RRR(K)
204 C 62 FORMAT(11,7,'NO CONVERGENCE FOR ',F5.2,' PERCENT RATE OF RETURN')
205 C GO TO 203
206 C 52 RRPRICE(KK) = RRPRICE(KK-1)
207 C GO TO 203
208 C 54 IF(DIF.LT.0.0) GO TO 55

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310 C
311 C
312 C

63 IF(CHEM.GT.1) CHEMCST(M) = 0.0
*****
SUM THE TOTAL COSTS THAT ARE EXPENSED BY YEARS.
*****
EXPENCST(M) = LIFCST(M)+INTANG(M)+GACST(M)+CHEMCST(M)
*****
CALCULATE THE NET OIL PRODUCTION.
*****
NOPROD(M) = GOPROD(M)*7-/8.
*****
CALCULATE THE GROSS INCOME OF THE WORKING INTEREST.
*****
IF(PRICECD.GT.1) GO TO 66
*****
GROSS INCOME EQUALS PRICE TIMES NET OIL PRODUCTION.
*****
GINCOME(M) = PRICE*NOPROD(M)
GO TO 67
*****
IF THE RATE OF RETURNS ARE READ IN GROSS INCOME MUST BE CALCULATED THIS WAY.
*****
64 GINCOME(M) = RRPRICE(KK)*NOPROD(M)
*****
CALCULATE THE GROSS INCOME BEFORE TAXES, DEPRECIATION AND DEPLETION.
*****

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313 67 GIBTD(M) = GINCOME(M) - EXPENCST(M)
314
315 *****
316
317 CALCULATE THE DEPRECIATION (STRAIGHT LINE, SUM OF THE YEAR DIGITS
318 DOUBLE DECLINING BALANCE, AND DOUBLE DECLINING BALANCE WITH
319 CONVERSION TO STRAIGHT LINE)
320
321 *****
322
323 IF(M.GT.2) GO TO 95
324 IF(DEPCODE.GT.1) GO TO 75
325 CALL SLD
326 GO TO 95
327 IF(DEPCODE.GT.2) GO TO 80
328 CALL SYOD
329 GO TO 95
330 IF(DEPCODE.GT.3) GO TO 85
331 CALL DDB
332 GO TO 95
333 IF(DEPCODE.GT.4) GO TO 90
334 CALL DDBSL
335 GO TO 95
336 90 WRITE(6,94) DEPCODE
337 94 FORMAT(1X,'DEPCODE =',I2,' AND IS INCORRECT')
338 STOP
339
340 *****
341
342 CALCULATE THE TOTAL TANGIBLE INVESTMENT COST (TTICST)
343
344 *****
345
346 95 KLIFE = PLIFE
347 IF(CHEMCST(M).LE.C.U) GO TO 105
348
349 *****
350
351 IF IT IS THE LAST YEAR OF THE PROJECT SUBTRACT THE SALVAGE VALUE
352
353 *****
354
355 IF(M.LT.KLIFE) GO TO 110
356 TTICST(M) = TANGIBLE(M)-STALSALV
357 GO TO 120
358 TTICST(M) = TANGIBLE(M)
359 GO TO 120
360 IF(M.LT.KLIFE) GO TO 115
361 TTICST(M) = TANGIBLE(M) + CHEMCOST(M) - STALSALV
362 GO TO 120
363 115 TTICST(M) = TANGIBLE(M) + CHEMCOST(M)
364

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365 C *****
366 C
367 C CALCULATE THE NET INCOME BEFORE FEDERAL AND STATE INCOME TAX.
368 C *****
369 C
370 C 120 NIBFSIT(M) = GIBTDD(M) - DEPRSHUN(M)
371 C
372 C *****
373 C
374 C *****
375 C IF DEPLETION CODE IS GREATER THAN ONE--DEPLETION ALLOWANCE IS
376 C DISREGARDED.
377 C *****
378 C
379 C *****
380 C IF(DEPLCODE.LE.1) GO TO 122
381 C PERDEPL(M) = 0.0
382 C CSTDEPL(M) = 0.0
383 C ALDEPL(M) = 0.0
384 C
385 C GO TO 135
386 C *****
387 C
388 C CALCULATION OF DEPLETION ALLOWANCE (COST AND PERCENTAGE)
389 C *****
390 C
391 C *****
392 C
393 C *****
394 C
395 C CALCULATION OF NFT DEPLETION INCOME
396 C *****
397 C
398 C *****
399 C 122 NDEPI(M) = .65*NIBFSIT(M)
400 C *****
401 C
402 C *****
403 C
404 C CALCULATE 22 PERCENT OF GROSS INCOME
405 C *****
406 C
407 C *****
408 C PERCENTG(M) = 0.22*GINCOME(M)
409 C PERDEPLL = NDEPI(M) - PERCENTG(M)
410 C IF (PERDEPLL) 125,125,130
411 C 125 PERDEPL(M) = NDEPI(M)
412 C *****
413 C
414 C IF PERCENT DEPLETION IS LESS THAN ZERO THEN PERCENT DEPLETION
415 C EQUALS ZERO.
416 C *****

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417 C *****
418 C IF(PERDEPL(M).LE.C.O) PERDEPL(M) = 0.0
419 C GO TO 135
420 C
421 C 130 PERDEPL(M) = PERCENTG(M)
422 C IF(PERDEPL(M).LE.C.O) PERDEPL(M) = 0.0
423 C
424 C *****
425 C
426 C PRODUCTION DURING AN ACCOUNTING YEAR IS ASSUMED TO BE TOTALLY
427 C SOLD.
428 C
429 C *****
430 C
431 C 135 PRODOH = 0.0
432 C PRODSOLD = NOPROD(M) - PRODOH
433 C IF(M.LE.1) GO TO 136
434 C SUMGOP(M) = GOPROD(M) + SUMGOP(M-1)
435 C GO TO 137
436 C 136 SUMGOP(M) = GOPROD(M)
437 C RECUNITS(M) = EORECOV - SUMGOP(M)
438 C IF(M.LE.1) GO TO 138
439 C SUMADPL(M) = ALDEPL(M-1) + SUMADPL(M-1)
440 C GO TO 139
441 C 138 SUMADPL(1) = 0.0
442 C 139 IF(M.LE.1) GO TO 140
443 C TLESHCST(M) = TLESHCST(M-1) + LEASHCST(M)
444 C GO TO 141
445 C 140 TLESHCST(M) = LEASHCST(M)
446 C 141 BASIS = TLESHCST(M) - SUMADPL(M)
447 C
448 C *****
449 C COST DEPLETION IS CALCULATED.
450 C
451 C *****
452 C
453 C CSTDPL(M) = BASIS*PRODSOLD/(RECUNITS(M) + PRODSOLD)
454 C IF(CSTDPL(M).LE.C.O) CSTDPL(M) = 0.0
455 C
456 C *****
457 C
458 C DETERMINE THE ALLOWABLE DEPLETION
459 C
460 C *****
461 C
462 C DIFFER = PERDEPL(M) - CSTDPL(M)
463 C IF(DIFFER) 145,142,142
464 C 142 ALDEPL(M) = PERDEPL(M)
465 C GO TO 150
466 C 145 ALDEPL(M) = CSTDPL(M)
467 C 150 IF(ALDEPL(M).LT.C.O) ALDEPL(M) = 0.0
468 C

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*****
DETERMINATION OF STATE AMORTIZATION FOR STATE TAX PURPOSES
*****

151 STAMORTIZ(M) = TTICST(M)/2.0
IF(M.LE.1) GO TO 155
STAMORTIS(M) = STAMORTIZ(M) + STAMORTIZ(M-1)
GO TO 160

155 STAMORTIS(M) = STAMORTIZ(M)
*****

DETERMINE TAXABLE INCOME
*****

160 TAXINC(M) = GIBTDD(M) - STAMORTIS(M)
*****

CALCULATE THE STATE INCOME TAX.
*****

IF(TAXINC(M).LE.25000.0) GO TO 165
STITAX(M) = 0.045*25000.00 + 0.0675*(TAXINC(M)-25000.00)
GO TO 170

165 STITAX(M) = 0.045*TAXINC(M)
*****

CALCULATION OF FEDERAL TAXABLE INCOME
*****

170 FEDTAXIN(M) = NIBFSIT(M) - ALDEPL(M) - STITAX(M)
*****

CALCULATION OF FEDERAL INCOME TAX
*****

FEDTATAX(M)=0.48*FEDTAXIN(M)
*****

CALCULATION OF NET CASH FLOW FOR THE PROJECT

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521 C *****
522 C NETCASHF(M)= GINCCME(M)-EXPENCST(M)- LEASHCST(M)-TTICST(M)-STITAX(
523 1M)-FEDINTAX(M)
524 SNCF = SNCF + NETCASHF(M)
525 30 CONTINUE
526 C *****
527 C
528 C TWO DO LOOPS ARE USED TO DETERMINE DISCOUNT FACTORS, PRESENT
529 C WORTHS, CUMULATIVE PRESENT WORTHS (PRESENT VALUES), AND RATE OF
530 C RETURNS.
531 C *****
532 C
533 C DO 200 L=1,10
534 C DO 200 M=1,KLIFE
535 C DCF(L,M)=1/(1.+INTEREST(L)/100.)*M
536 C PW(L,M) = NETCASHF(M)*DCF(L,M)
537 C IF(M.GT.1) GO TO 205
538 C CUMPW(L,M) = PW(L,M)
539 C GO TO 200
540 C 205 CUMPW(L,M) = PW(L,M) + CUMPW(L,M-1)
541 C IF(L.LT.1.OR.M.LT.KLIFE) GO TO 200
542 C *****
543 C
544 C IF THERE IS A CHANGE OF SIGN BETWEEN THE NET CASH FLOW DISCOUNTED
545 C AT ZERO PERCENT AND 5 PERCENT THE RATE OF RETURN WILL BE
546 C CALCULATED.
547 C *****
548 C
549 C IF(L.LE.1.AND.M.GE.KLIFE) GO TO 211
550 C IF(M.GE.KLIFE) GO TO 209
551 C GO TO 200
552 C 211 IF(SNCF.GT.0.0.AND.CUMPW(L,KLIFE).GT.0.0) GO TO 200
553 C IF(SNCF.LT.0.0.AND.CUMPW(L,KLIFE).LT.0.0) GO TO 200
554 C IF(SNCF.LT.0.0.AND.CUMPW(L,KLIFE).GE.0.0) GO TO 206
555 C IF(SNCF.GE.0.0.AND.CUMPW(L,KLIFE).LT.0.0) GO TO 207
556 C 206 DIFF = ABS(SNCF) + ABS(CUMPW(L,KLIFE))
557 C PR = L*5. + ((CUMPW(L,KLIFE))/DIFF)*(L*5.)
558 C GO TO 200
559 C 207 DIFF = ABS(SNCF) + ABS(CUMPW(L,KLIFE))
560 C PR = (SNCF/DIFF)*(L*5.)
561 C GO TO 200
562 C *****
563 C
564 C DETERMINATION OF THE RATE OF RETURN
565 C *****
566 C
567 C
568 C
569 C
570 C
571 C
572 C

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573 C
574 C      DETERMINATION OF THE RATE OF RETURN IF THERE IS A CHANGE OF SIGN
575 C      THE CUMULATIVE PRESENT WORTH AND THE PREVIOUS CUMULATIVE PRESENT
576 C      WORTH.
577 C
578 C      *****
579 C
580 C      200 IF(CUMPW(L,KLIFE)) 210,215,220
581 C      210 IF(CUMPW(L-1,KLIFE).LT.0.0) GO TO 200
582 C
583 C      *****
584 C
585 C      AN INTERPOLATION FORMULA IS USED TO DETERMINE THE RATE OF RETURN.
586 C
587 C      *****
588 C
589 C      DIFF = ABS(CUMPW(L,KLIFE)) + ABS(CUMPW(L-1,KLIFE))
590 C      RR = (L-1)*5. + ((CUMPW(L-1,KLIFE))/DIFF)*(L*5.-(L-1)*5.)
591 C      GO TO 200
592 C
593 C      215 RR = L*5.
594 C      GO TO 200
595 C
596 C      220 IF(CUMPW(L-1,KLIFE).GT.0.0) GO TO 200
597 C      DIFF = ABS(CUMPW(L,KLIFE)) + ABS(CUMPW(L-1,KLIFE))
598 C      RR = L*5. + ((CUMPW(L,KLIFE))/DIFF)*(L*5.-(L-1)*5.)
599 C
600 C      200 CONTINUE
601 C      IF(PRICECD.NE.2) GO TO 201
602 C      IF((RR-RRC(KK-1)).EQ.0.0) GO TO 199
603 C      GO TO 202
604 C
605 C      199 IF(CUMPW(10,KLIFE).GT.0.0) RRPRICE(KK)=RRPRICE(KK)-5.
606 C      IF(CUMPW(10,KLIFE).LT.0.0) RRPRICE(KK)=RRPRICE(KK)+5.
607 C      GO TO 65
608 C
609 C      202 CONTINUE
610 C      203 CONTINUE
611 C      IF(PRICECD.GE.2) GO TO 400
612 C
613 C      201 DO 204 JM=2,11
614 C      KINTREST(JM) = INTEREST(JM-1)
615 C      PVALUE(JM) = CUMPW(JM-1,KLIFE)
616 C      KINTREST(1) = 0.0
617 C      PVALUE(1) = SNCF
618 C      CALL SUMMARY (LOC,TODM,TODP,FIELD,PRODSAND,SIZE,SPACE,NIJW,NPROD,
619 C      1PRICE,RR,TDEPR,ADEPLA,CHEMI,PATTERN,MICELCST,POLYMCST,KLIFE,LIFTA
620 C      2CT,WATERIC,WATERDC,MICELLJC,POLYMIJC,GOPRODIC)
621 C      IF(PRICECD.GT.1) GO TO 400
622 C      CALL OUTPUT
623 C      IF(PRICECD.GT.1) GO TO 400
624 C      READ(S,200) (LABEL(JJJ),JJJ=1,14)
625 C      FORMAT(13A6,A2)
626 C      CALL HISA (1,KINTREST,PVALUE,KLIFE+1,P,IN,N-1,LABEL)
627 C      RR = 0.0
628 C      SNCF = 0.0
629 C      GO TO 100
630 C
631 C      400 CALL HEADING (LOC,TODM,TODP,FIELD,PRODSAND,SIZE,SPACE,NIJW,NPROD,

```

625 1TDEPR, ADEPLA, CHEMI, PATTERN, MICELCST, POLYMCST, KLIFE, LIFTFACT, WATERI
626 2C, WATERDC, MICELIJC, POLYMIJC, GOPRODTC)
627 CALL WRITEOUT (RIPRICE)
628 GO TO 100
629 700 STOP
630 END


```

53      DO 35 JJ=1,N-1
54      CSALVAGE = 0.0
55      DO 45 MM=1,N
56      *****
57      C
58      C
59      C      NOTE- NO SALVAGE VALUE IS CALCULATED FOR THE CHEMICALS BECAUSE
60      C      THEY ARE CONSIDERED UNRECOVERABLE FOR FUTURE USE.
61      C
62      C
63      C
64      C      CDEP(JJ,MM) = (CHEMCOST(JJ)-CSALVAGE)/(N-JJ)
65      C
66      C      45 CONTINUE
67      C      35 CONTINUE
68      C
69      C
70      C      TWO DO LOOPS ARE USED TO SUM THE CALCULATED DEPRECIATION OF THE
71      C      POLYMER AND MICELLAR SOLUTION IN A PARTICULAR YEAR IF THE
72      C      CHEMICALS ARE CAPITALIZED.
73      C
74      C
75      C
76      C
77      C      DO 50 LN=1,N-1
78      C      DO 53 JJ=1,LN
79      C      MM = LN-JJ+1
80      C      IF(JJ.EQ.1) YCDEP(LN) = 0.0
81      C      YCDEP(LN) = CDEP(JJ,MM) + YCDEP(LN)
82      C
83      C      53 CONTINUE
84      C      50 CONTINUE
85      C
86      C
87      C
88      C      THREE DO LOOPS ARE USED TO SUM DEPRECIATION OF INVESTMENTS IN
89      C      ANY YEAR WITH ANY GROUP LIFE OF 5, 10, 15, 20, AND 25 YEARS AND
90      C      THE CHEMICAL INVESTMENTS DEPRECIATION IN ANY YEAR WITH A LIFE UP
91      C      TO PROJECT LIFE.
92      C
93      C
94      C
95      C      DO 55 K=1,N-1
96      C      STDEP = 0.0
97      C      DO 65 J=1,K
98      C      DO 65 L=1,5
99      C      IF(K.GE.L*5+1) GO TO 61
100     C      STDEP = STDEP + TDEP(J,L,K)
101     C      GO TO 65
102     C      61 IF((J+K-L*5).GT.K) GO TO 65
103     C      STDEP = STDEP + TDEP(J+K-L*5,L,K)
104     C      65 CONTINUE
105     C      DEPRSHUNK(K) = YCDEP(K) + STDEP
106     C      55 CONTINUE

```

RETURN
END

105
106


```

53 C *****
54 C TWO DO LOOPS ARE USED TO CALCULATE THE DEPRECIATION OF THE
55 C POLYMER AND THE MICELLAR SOLUTIONS IF THEY ARE TO BE CAPITALIZED.
56 C *****
57 C
58 C
59 C
60 C DO 35 JJ=1,N
61 C NN = 0
62 C MSUM = 0
63 C DO 40 K=1,N-JJ
64 C MSUM = MSUM + K
65 C 40 CONTINUE
66 C SUM = MSUM
67 C CSALVAG = 0.0
68 C DO 45 MM=1,N
69 C *****
70 C
71 C
72 C NOTE- NO SALVAGE VALUE IS CALCULATED FOR THE CHEMICALS BECAUSE
73 C THEY ARE CONSIDERED UNRECOVERABLE FOR FUTURE USE.
74 C *****
75 C
76 C
77 C CDEP(JJ,MM) = (CHEMCOST(JJ)-CSALVAG)*(N-JJ-NN)/SUM
78 C NN = NN + 1
79 C 45 CONTINUE
80 C 35 CONTINUE
81 C *****
82 C
83 C
84 C TWO DO LOOPS ARE USED TO SUM THE CALCULATED DEPRECIATION OF THE
85 C POLYMER AND MICELLAR SOLUTION IN A PARTICULAR YEAR IF THE
86 C CHEMICALS ARE CAPITALIZED.
87 C *****
88 C
89 C
90 C DO 50 LN=1,N
91 C DO 53 JJ=1,NN
92 C MM = LN-JJ+1
93 C IF(JJ.EQ.1) YCDEP(LN) = 0.0
94 C YCDEP(LN) = CDEP(JJ,MM) + YCDEP(LN)
95 C 53 CONTINUE
96 C 50 CONTINUE
97 C *****
98 C
99 C
100 C THREE DO LOOPS ARE USED TO SUM DEPRECIATION OF INVESTMENTS IN
101 C ANY YEAR WITH ANY GROUP LIFE OF 5, 10, 15, 20, AND 25 YEARS AND
102 C THE CHEMICAL INVESTMENTS DEPRECIATION IN ANY YEAR WITH A LIFE UP
103 C TO PROJECT LIFE.
104 C

```

```

105 C
106 C
107 *****
108 DO 55 K=1,N-1
109 STDEP = 0.0
110 DO 65 J=1,K
111 DO 65 L=1,5
112 IF (K.GE.L*5+1) GO TO 61
113 STDEP = STDEP + TDEP(J,L,K)
114 GO TO 65
115 61 IF ((J+K-L*5).GT.K) GO TO 65
116 STDEP = STDEP + TDEP(J+K-L*5,L,K)
117 65 CONTINUE
118 DEPRSHUN(K) = YCDEP(K) + STDEP
119 55 CONTINUE
120 RETURN
    END

```

```

1 C
2 C
3 C
4 C
5 C
6 C
7 C
8 C
9 C
10 C
11 C
12 C
13 C
14 C
15 C
16 C
17 C
18 C
19 C
20 C
21 C
22 C
23 C
24 C
25 C
26 C
27 C
28 C
29 C
30 C
31 C
32 C
33 C
34 C
35 C
36 C
37 C
38 C
39 C
40 C
41 C
42 C
43 C
44 C
45 C
46 C
47 C
48 C
49 C
50 C
51 C
52 C

*****
THIS SUBROUTINE, DOUBLE DECLINING BALANCE, CALCULATES THE
DEPRECIATION BY YEAR FOR AN INVESTMENT IN ANY YEAR THAT MIGHT BE
GROUPED INTO A DEPRECIABLE LIFE OF 5, 10, 15, 20, AND 25 YEARS.
IT ALSO PROVIDES A SALVAGE VALUE EQUAL TO THE UNDEPRECIABLE
INVESTMENT SO AS TO AFFECT THE NET CASH FLOW OF THE PROJECT.
*****
SUBROUTINE DDB
COMMON TANGI(26,5),CHEMCOST(26),DEPRSHUN(26),PLIFE,STSALVAG,TDEP(2
16,5,26),CDEP(26,26),YCDP(26),YEAR(26),COPROD(26),LEASHCST(26),INT
PANG(26),GACST(26),LIFTCT(26),TANGIBLE(26),CHEMCST(26),RRR(10),RRP
3RICE(10),EXPENCST(26),NOPROD(26),GINCOME(26),GIBTDD(26),TILCST(26)
4NIRFSIT(26),PERDEPL(26),CSTDEPL(26),ALDEPL(26),NDEPI(26),PERCENTG
5(26),STAMORTS(26),TAXINC(26),STITAX(26),FEDTAXIN(26),FEDINTAX(26),
6NETCASHE(26),DCF(10,26),PW(10,26),CUMPW(10,26),RR,KLIFE,SNCF
N = PLIFE + 1.0
STSALVAG = 0.0
*****
THREE DO LOOPS ARE USED TO CALCULATE THE DEPRECIATION BY YEAR OF
INVESTMENT (J), DEPRECIABLE LIFE (L), AND DEPRECIATION VALUE YEAR
(K).
*****
DO 20 L=1,5
LIFE = L*5
DO 15 J=1,N
SUMDEP = 0.0
KLIFE = LIFE + J
IF(KLIFE.GT.PLIFE) KLIFE = PLIFE
SUM = 0.0
DO 30 K=J,KLIFE
DIFF = TANGI(J,L) - SUM
*****
IF DOUBLE DECLINING BALANCE IS IN ITS LAST YEAR OF DEPRECIABLE
LIFE, DEPRECIATION FOR THAT YEAR IS THE REMAINING UNDEPRECIATED
INVESTMENT.
*****
IF(L*5-K.EQ.0) GO TO 75
TDEP(J,L,K) = DIFF*2.00/(L*5.)
GO TO 80
75 TDEP(J,L,K) = DIFF

```

```

53      80 SUM = TDEP(J,L,K) + SUM
54      C
55      C *****
56      C
57      C CALCULATES THE UNDEPRECIATED VALUE OF THE INVESTMENTS WHICH
58      C PASS THE PROJECT LIFE.
59      C
60      C *****
61      C
62      IF(L*5+J-GT,N) SUMDEP = SUMDEP + TDEP(J,L,K)
63      30 CONTINUE
64      IF(L*5+J-GT,N) STSALVAG = STSALVAG - SUMDEP + TANGI(J,L)
65      15 CONTINUE
66      20 CONTINUE
67      C
68      C *****
69      C
70      C TWO DO LOOPS ARE USED TO CALCULATE THE DEPRECIATION OF THE
71      C POLYMER AND THE MICELLAR SOLUTIONS IF THEY ARE TO BE CAPITALIZED.
72      C
73      C *****
74      C
75      DO 35 JJ=1,N-1
76      SUMM = 0.0
77      DO 45 MM=JJ,N-1
78      C
79      C *****
80      C
81      C NOTE- NO SALVAGE VALUE IS CALCULATED FOR THE CHEMICALS BECAUSE
82      C THEY ARE CONSIDERED UNRECOVERABLE FOR FUTURE USE.
83      C
84      C *****
85      C
86      DIFFER = CHEMCOST(JJ) - SUMM
87      CDEP(JJ,MM) = DIFFER*2.00/(N-JJ)
88      CSLD = DIFFER/(N-MM)
89      IF(CSLD.GE.CDEP(JJ,MM)) CDEP(JJ,MM) = CSLD
90      47 SUMM = CDEP(JJ,MM) + SUMM
91      45 CONTINUE
92      35 CONTINUE
93      C
94      C *****
95      C
96      C TWO DO LOOPS ARE USED TO SUM THE CALCULATED DEPRECIATION OF THE
97      C POLYMER AND MICELLAR SOLUTION IN A PARTICULAR YEAR IF THE
98      C CHEMICALS ARE CAPITALIZED.
99      C
100     C *****
101     C
102     DO 50 LN=1,N
103     DO 55 JJ=1,LN
104     IF(JJ.EQ.1) YCDEP(L,J) = 0.0

```

```

105 YCDEP(LN) = CDEP(JJ,MM) + YCDEP(LN)
106 53 CONTINUE
107 50 CONTINUE
108
109 *****
110
111 C THREE DO LOOPS ARE USED TO SUM DEPRECIATION OF INVESTMENTS IN
112 C ANY YEAR WITH ANY GROUP LIFE OF 5, 10, 15, 20, AND 25 YEARS AND
113 C THE CHEMICAL INVESTMENTS DEPRECIATION IN ANY YEAR WITH A LIFE UP
114 C TO PROJECT LIFE.
115 C
116 *****
117 C
118 DO 55 K=1,N-1
119 STDEP = 0.0
120 DO 65 J=1,K
121 DO 65 L=1,5
122 IF (K.GE.L*5+1) GO TO 61
123 STDEP = STDEP + TDEP(J,L,K)
124 GO TO 65
125 61 IF ((J+K-L*5).GT.K) GO TO 65
126 STDEP = STDEP + TDEP(J+K-L*5,L,K)
127 65 CONTINUE
128 DEPRSHUN(K) = YCDEP(K) + STDEP
129 55 CONTINUE
130 RETURN
131 END

```

```

1 C
2 C
3 C
4 C
5 C
6 C
7 C
8 C
9 C
10 C
11 C
12 C
13 C
14 C
15 C
16 C
17 C
18 C
19 C
20 C
21 C
22 C
23 C
24 C
25 C
26 C
27 C
28 C
29 C
30 C
31 C
32 C
33 C
34 C
35 C
36 C
37 C
38 C
39 C
40 C
41 C
42 C
43 C
44 C
45 C
46 C
47 C
48 C
49 C
50 C
51 C
52 C

*****
THIS SUBROUTINE, DOUBLE DECLINING BALANCE WITH CONVERSION TO
STRAIGHT LINE DEPRECIATION, CALCULATES THE DEPRECIATION BY YEAR
FOR AN INVESTMENT IN ANY YEAR THAT MIGHT BE GROUPED INTO A
DEPRECIABLE LIFE OF 5, 10, 15, 20 AND 25 YEARS. IT ALSO PROVIDES
A SALVAGE VALUE EQUAL TO THE UNDEPRECIABLE INVESTMENT SO AS TO
AFFECT THE NET CASH FLOW OF THE PROJECT.
*****
SUBROUTINE DDHSL
COMMON TANGI(26,5),CHEMCOST(26),DEPRSHUN(26),PLIFE,STLSALVAG,TDEP(2
16,5,26),CDEP(26,26),YCDP(26),YEAR(26),GOPROD(26),LEASHCST(26),INT
2ANG(26),GACST(26),LIFCST(26),TANGIBLE(26),CHEMCST(26),RRR(10),RRP
3RICE(10),EXPENCST(26),NOPROD(26),GINCOME(26),GIBTDD(26),TICST(26)
4MIRFSIT(26),PERDEPL(26),CSTDEPL(26),ALDEPL(26),NDEPL(26),PERCENTG
5(26),STAMORTS(26),TAXINC(26),STITAX(26),FEDTAXIN(26),FEDINTAX(26),
6METCASHF(26),OCF(10,26),PW(10,26),CUMPPW(10,26),RR,KLIFE,SNCF
N = PLIFE + 1.0
STLSALVAG = 0.0
*****
THREE DO LOOPS ARE USED TO CALCULATE THE DEPRECIATION BY YEAR OF
INVESTMENT (J), DEPRECIABLE LIFE (L), AND DEPRECIATION VALUE YEAR
(K).
*****
DO 20 L=1,5
LIFE = L*5
DO 15 J=1,N
SUNDFP = 0.0
KLIFE = LIFE + J - 1
IF(KLIFE.GT.PLIFE) KLIFE = PLIFE
SUM = 0.0
M = 1
DO 30 K=J,KLIFE
DIFF = TANGI(J,L) - SUM
TDEP(J,L,K) = DIFF*2.00/(L*5.)
IF(K-GE-L*5+1) M = L*5+1
IF((L*5-K*M).EQ.0) GO TO 75
*****
IF DOUBLE DECLINING BALANCE IS LESS THAN WHAT STRAIGHT LINE
DEPRECIATION, THEN THE REST OF THE UNDEPRECIATED INVESTMENT IS
DEPRECIATED AS STRAIGHT LINE BUT ANY NEW INVESTMENT CAN BE AGAIN
DEPRECIATED BY THE DOUBLE DECLINING BALANCE METHOD.

```

```

53 C
54 C
55 C
56 SLD = DIFF/((L*S)-K+M)
57 IF (TDEP(J,L,K).LT.SLD) TDEP(J,L,K) = SLD
58 SUM = TDEP(J,L,K) + SUM
59 REMAIND = TANGI(J,L) - SUM
60 IF (REMAIND-GE.SLD) TDEP(J,L,K+1) = SLD
61 IF (REMAIND.LE.SLD) TDEP(J,L,K+1) = REMAIND
62
63 C
64 C
65 C
66 C
67 C
68 C
69 C
70 C
71 IF (L*S+J.GT.N) SUMDEP = SUMDEP + TDEP(J,L,K)
72 IF (REMAIND.LE.TDEP(J,L,K+1)) SUMDEP = SUMDEP + TDEP(J,L,K+1)
73 30 CONTINUE
74 IF (L*S+J.GT.N) STSALVAG = STSALVAG - SUMDEP + TANGI(J,L)
75 15 CONTINUE
76 20 CONTINUE
77 C
78 C
79 C
80 C
81 C
82 C
83 C
84 C
85 C
86 C
87 C
88 C
89 C
90 C
91 C
92 C
93 C
94 C
95 C
96 C
97 C
98 C
99 C
100 C
101 C
102 C
103 C
104 C

*****
SLD = DIFF/((L*S)-K+M)
IF (TDEP(J,L,K).LT.SLD) TDEP(J,L,K) = SLD
75 SUM = TDEP(J,L,K) + SUM
REMAIND = TANGI(J,L) - SUM
IF (REMAIND-GE.SLD) TDEP(J,L,K+1) = SLD
IF (REMAIND.LE.SLD) TDEP(J,L,K+1) = REMAIND
*****
CALCULATES THE UNDEPRECIATED VALUE OF THE INVESTMENTS WHICH
PASS THE PROJECT LIFE.
*****
IF (L*S+J.GT.N) SUMDEP = SUMDEP + TDEP(J,L,K)
IF (REMAIND.LE.TDEP(J,L,K+1)) SUMDEP = SUMDEP + TDEP(J,L,K+1)
30 CONTINUE
IF (L*S+J.GT.N) STSALVAG = STSALVAG - SUMDEP + TANGI(J,L)
15 CONTINUE
20 CONTINUE
*****
TWO DO LOOPS ARE USED TO CALCULATE THE DEPRECIATION OF THE
POLYMER AND THE PICELLAR SOLUTIONS IF THEY ARE TO BE CAPITALIZED.
*****
DO 35 JJ=1,N-1
SUMM = C.O
DO 45 MM=JJ,N-1
*****
NOTE- NO SALVAGE VALUE IS CALCULATED FOR THE CHEMICALS BECAUSE
THEY ARE CONSIDERED UNRECOVERABLE FOR FUTURE USE.
*****
DIFFER = CHEMCOST(JJ) - SUMM
CDEP(JJ,MM) = DIFFER*2.00/(N-JJ)
CSLD = DIFFER/(N-MM)
IF (CSLD-GE.CDEP(JJ,MM)) CDEP(JJ,MM) = CSLD
47 SUMM = CDEP(JJ,MM) + SUMM
45 CONTINUE
35 CONTINUE
*****

```

```

105 C      TWO DO LOOPS ARE USE TO SUM THE CALCULATED DEPRECIATION OF THE
106 C      POLYMER AND MICELLAR SOLUTION IN A PARTICULAR YEAR IF THE
107 C      CHEMICALS ARE CAPITALIZED.
108 C
109 C      *****
110 C
111 C      DO 50 LN=1,N
112 C      DO 53 JJ=1,LN
113 C      IF(JJ.EQ.1) YCDEP(LN) = 0.0
114 C      YCDEP(LN) = CDEP(JJ,MM) + YCDEP(LN)
115 C
116 C      53 CONTINUE
117 C      50 CONTINUE
118 C
119 C      *****
120 C
121 C      THREE DO LOOPS ARE USED TO SUM DEPRECIATION OF INVESTMENTS IN
122 C      ANY YEAR WITH ANY GROUP LIFE OF 5, 10, 15, 20, AND 25 YEARS AND
123 C      THE CHEMICAL INVESTMENTS DEPRECIATION IN ANY YEAR WITH A LIFE UP
124 C      TO PROJECT LIFE.
125 C
126 C      *****
127 C
128 C      DO 55 K=1,N-1
129 C      STDEP = 0.0
130 C      DO 65 J=1,K
131 C      DO 65 L=1,5
132 C      IF(K.GE.L*5+1) GO TO 61
133 C      STDEP = STDEP + TDEP(J,L,K)
134 C      GO TO 65
135 C      61 IF((J+K-L*5).GT.K) GO TO 65
136 C      STDEP = STDEP + TDEP(J+K-L*5,L,K)
137 C      65 CONTINUE
138 C      DEPRSHUN(K) = YCDEP(K) + STDEP
139 C      RETURN
140 C      END

```



```
53 IF(RR-LE.0.0) GO TO 290
54 GO TO 310
55 290 WRITE(6,300)
56 300 FORMAT(//,T18,'(THE RATE OF RETURN IS GREATER THAN 50 PERCENT OR I
57 1S EQUAL TO ZERO PERCENT)')
58 310 RETURN
59 END
```



```

53 25 CONTINUE
54 WRITE(6,26) SGOPROD,SNOPROD,SGINCOME,STANG,SCHEMCST,SLIFTCST,SGA
55 1CST,SEXPECST
56 26 FORMAT(/,T2,'SUR TOTAL',T12,F12.2,T26,F12.2,T41,F14.2,T59,F12.2,T7
57 14,F11.2,T89,F11.2,T103,F12.2,T119,F12.2)
58 WRITE(6,5)
59 5 FORMAT(1H1,T4,'YEAR',T13,'GROSS INCOME',T27,'CAPITALIZED',T43,'TAN
60 1GIBLE',T57,'NET TANGIBLE',T74,'DEPRECIATION',T89,'NET INCOME',T104
61 2,'65 PERCENT',T120,'22 PERCENT',/T12,'BEFORE TAX AND',T28,'CHEMIC
62 3AL',T42,'INVESTMENT',T58,'INVESTMENT',T75,'SL/SYOD/DOB',T88,'BEFOR
63 4E STATE',T103,'OF NET INCOME',T123,'OF',/T12,'DEPL AND DEPR',T3C,
64 5'COST',T45,'COST',T56,'MINUS SALVAGE',T77,'DBSL',T88,'AND FED TAX
65 6ES',T106,'BSFT',T119,'GROSS INCOME',/T13,'(YEARS)',T14,'(DOLLARS)',
66 7,T29,'(DOLLARS)',T43,'(DOLLARS)',T58,'(DOLLARS)',T75,'(DOLLARS)',T
67 890,'(DOLLARS)',T115,'(DOLLARS)',T120,'(DOLLARS)',/T16,'(10)',T3C,
68 9,'(11)',T45,'(12)',T60,'(13)',T77,'(14)',T92,'(15)',T107,'(16)',T12
69 12,'(17)',/T15,'(4-9)',T56,'(11+12-SALVAGE)',T91,'(10-14)',T105,'(
70 2.65X15)',T121,'(.22X4)',/T13,'-----',T12,'-----',T27,'-----
71 3-----',T42,'-----',T56,'-----',T12,'-----',T74,'-----'
72 4-----',T88,'-----',T103,'-----',T119,'-----')
73 DO 6 I=1,KLIFE
74 6 WRITE(6,4) YEAR(I),GIBTDD(I),CHEMCST(I),TANGIBLE(I),TITCST(I),DEP
75 1RSHUN(I),NIRFSIT(I),NDEPI(I),PERCENTG(I)
76 SGIBTDD = 0.0
77 SCHECST = 0.0
78 STANGIBL = 0.0
79 STITCST = 0.0
80 SDEPSHUN = 0.0
81 SNIRFSIT = 0.0
82 SNDEPI = 0.0
83 SPERCETG = 0.0
84 DO 27 L=1,KLIFE
85 SGIBTDD = SGIBTDD + GIBTDD(L)
86 SCHECST = SCHECST + CHEMCST(L)
87 STANGIBL = STANGIBL + TANGIBLE(L)
88 STITCST = STITCST + TITCST(L)
89 SDEPSHUN = SDEPSHUN + DEPRSHUN(L)
90 SNIRFSIT = SNIRFSIT + NIRFSIT(L)
91 SNDEPI = SNDEPI + NDEPI(L)
92 SPERCETG = SPERCETG + PERCENTG(L)
93 27 CONTINUE
94 WRITE(6,26) SGIBTDD,SCHECST,STANGIBL,STITCST,SDEPSHUN,SNIRFSIT,SN
95 1EPI,SPERCETG
96 WRITE(6,7)
97 7 FORMAT(1H1,T4,'YEAR',T14,'PERCENT',T25,'LEASEHOLD',T39,'COST',T48,
98 1'ALLOWABLE',T64,'STATE',T77,'TAXABLE',T88,'STATE INCOME',T102,'FED
99 2ERAL TAXABLE',T119,'FEDERAL INCOME',/T13,'DEPLETION',T27,'COST',T
100 337,'DEPLETION',T49,'DEPLETION',T60,'AMORTIZATION',T78,'INCOME',T92
101 4,'TAX',T106,'INCOME',T124,'TAX',/T16,'(18)',T27,'(19)',T39,'(20)',
102 5,T50,'(21)',T64,'(22)',T79,'(23)',T92,'(24)',T107,'(25)',T123,'(26
103 6)',/T13,'(LESSOR)',T48,'(GREATER)',T62,'(13/2.0)',T77,'(10-22)',T
104 738,'(.043+25000)+',T104,'(15-12-24)',T121,'(.48+25)/T13,'(16 OR 1

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105 87)' ,T43,'(18 OR 2C)' ,T60,'(+ CARRY FWD)' ,T86,'.0675*(22-25000.)' /T
106 93,'(YEARS)' ,T13,'(DOLLARS)' ,T25,'(DOLLARS)' ,T37,'(DOLLARS)' ,T48,'(
107 100DOLLARS)' ,T62,'(DOLLARS)' ,T76,'(DOLLARS)' ,T89,'(DOLLARS)' ,T105,'(D
108 200DOLLARS)' ,T121,'(DOLLARS)' /T3,'-----' ,T13,'-----' ,T25,'-----
109 3-----' ,T37,'-----' ,T48,'-----' ,T60,'-----' ,T76,'-----
110 4-----' ,T86,'-----' ,T103,'-----' ,T119,'-----
111 5-----')
112 DO 8 I=1,KLIFE
113 8 WRITE(6,9) YEAR(I),PERDEPL(I),LEASHCST(I),CSTDEPL(I),ALDEPL(I),STA
114 1MORTS(I),TAXINC(I),SSTIAX(I),FEDTAXIN(I),FEDTAXI(I)
115 9 FORMAT(I5,I2,I12,I10.2,I24,F10.2,I36,F10.2,I47,F11.2,I60,F12.2,I75
116 1,F11.2,I88,F11.2,I104,F12.2,I120,F12.2)
117 SPERDEPL = 0.0
118 SLESHCST = 0.0
119 SCSTDEPL = 0.0
120 SALDEPL = 0.0
121 SSTAMOTS = 0.0
122 STAXINC = 0.0
123 SSTIAX = 0.0
124 SFEDTAXI = 0.0
125 SFEDITAX = 0.0
126 DO 28 L=1,KLIFE
127 SPERDEPL = SPERDEPL + PERDEPL(L)
128 SLESHCST = SLESHCST + LEASHCST(L)
129 SCSTDEPL = SCSTDEPL + CSTDEPL(L)
130 SALDEPL = SALDEPL + ALDEPL(L)
131 SSTAMOTS = SSTAMOTS + STAMOTS(L)
132 STAXINC = STAXINC + TAXINC(L)
133 SSTIAX = SSTIAX + STIAX(L)
134 SFEDTAXI = SFEDTAXI + FEDTAXIN(L)
135 SFEDITAX = SFEDITAX + FEDTAXI(L)
136 28 CONTINUE
137 WRITE(6,29) SPERDEPL,SLESHCST,SCSTDEPL,SALDEPL,SSTAMOTS,STAXINC,SS
138 1TITAX,SFEDTAXI,SFEDITAX
139 29 FORMAT(/,I1,'SUR TOTAL',I12,F10.2,I24,F10.2,I36,F10.2,I47,F11.2,I6
140 10,F12.2,I75,F11.2,I88,F11.2,I104,F12.2,I120,F12.2)
141 WRITE(6,10)
142 10 FORMAT(IH1,I4,'YEAR',I15,'NET',I26,'DISCOUNT',I39,'PRESENT WORTH',
143 1T56,'CUMULATIVE',I71,'PRESENT WORTH',T89,'CUMULATIVE',I104,'PRESEN
144 2T WORTH',I122,'CUMULATIVE' /,I15,'CASH',I27,'FACTOR',I44,'AT',I55
145 3,'PRESENT WORTH',I76,'AT',I88,'PRESENT WORTH',I109,'AT',I120,'PRES
146 4ENT WORTH',I115,'FLOW',I24,'AT 5 PERCENT',I41,'5 PERCENT',I55,'A
147 5T 5 PERCENT',I72,'10 PERCENT',I88,'AT 10 PERCENT',I105,'15 PERCE
148 6NT',I120,'AT 15 PERCENT',I115,'(27)',I28,'(28)',I43,'(29)',I59,'(
149 730)',I76,'(31)',I92,'(33)',I109,'(34)',I125,'(35)' /,I42,'(27X28)'
150 8,I74,'(27XDCF)',I107,'(27XDCF)' /,I3,'(YEARS)',I12,'(DOLLARS)',I26
151 9,'(PERCENT)',I41,'(DOLLARS)',I57,'(DOLLARS)',I73,'(DOLLARS)',I90,'
152 1(DOLLARS)',I106,'(DOLLARS)',I122,'(DOLLARS)' /,I3,'-----' ,I12,'-
153 2-----' ,I24,'-----' ,I39,'-----' ,I55,'-----' ,I119,'-----' ,I1
154 3,'-----' ,I188,'-----' ,I104,'-----' ,I1
155 420,'-----')
156 L = 1

```

```

157 DO 11 I=1,KLIFE
158 11 WRITE(6,12) YEAR(1),NETCASHF(1),DCF(L,1),PW(L,1),CUMPW(L,1),PW(L+1
159 1,1),CUMPW(L+1,1),FW(L+2,1),CUMPW(L+2,1)
160 12 FORMAT(15,I2,11,F12.2,T24,F11.6,T39,F13.2,T55,F13.2,T71,F13.2,T88
161 1,F13.2,T104,F13.2,T120,F13.2)
162 WRITE(6,23) SNCF,CUMPW(L,KLIFE),CUMPW(L+1,KLIFE),CUMPW(L+2,KLIFE)
163 23 FORMAT(7,I1,'TOTAL',T10,F12.2,T55,F13.2,T88,F13.2,T120,F13.2)
164 WRITE(6,13)
165 13 FORMAT(1H1,I3,'YEAR',T10,'PRESENT WORTH',T25,'CUMULATIVE',T39,'PRE
166 1SENT WORTH',T56,'CUMULATIVE',T71,'PRESENT WORTH',T89,'CUMULATIVE',
167 2T104,'PRESENT WORTH',T122,'CUMULATIVE',T15,'AT',T24,'PRESENT WORT
168 3H',T44,'AT',T55,'PRESENT WORTH',T76,'AT',T88,'PRESENT WORTH',T109,
169 4'AT',T120,'PRESENT WORTH',T111,'20 PERCENT',T24,'AT 20 PERCENT',
170 5T41,'25 PERCENT',T55,'AT 25 PERCENT',T72,'30 PERCENT',T88,'AT 30 P
171 6PERCENT',T105,'35 PERCENT',T120,'AT 35 PERCENT',T14,'(36)',T28,'(
172 737)',T43,'(38)',T59,'(39)',T76,'(40)',T92,'(41)',T109,'(42)',T125,
173 8'(43)',T113,'(27XDCF)',T42,'(27XDCF)',T74,'(27XDCF)',T107,'(27XDC
174 9F)',T12,'(YEARS)',T112,'(DOLLARS)',T26,'(DOLLARS)',T41,'(DOLLARS)',
175 1'T57,'(DOLLARS)',T73,'(DOLLARS)',T90,'(DOLLARS)',T106,'(DOLLARS)',
176 2T122,'(DOLLARS)',T12,'(DOLLARS)',T10,'(DOLLARS)',T24,'(DOLLARS)',
177 3'---',T39,'(DOLLARS)',T55,'(DOLLARS)',T71,'(DOLLARS)',T88,'(DOLLARS)',
178 48,'(DOLLARS)',T104,'(DOLLARS)',T120,'(DOLLARS)',T12,'(DOLLARS)',
179 L = 4
180 DO 14 I=1,KLIFE
181 14 WRITE(6,15) YEAR(1),PW(L,1),CUMPW(L,1),FW(L+1,1),CUMPW(L+1,1),PW(L
182 1+2,1),CUMPW(L+2,1),PW(L+3,1),CUMPW(L+3,1)
183 15 FORMAT(14,I2,T10,F13.2,T24,F13.2,T39,F13.2,T55,F13.2,T71,F13.2,T88
184 1,F13.2,T104,F13.2,T120,F13.2)
185 WRITE(6,30) CUMPW(L,KLIFE),CUMPW(L+1,KLIFE),CUMPW(L+2,KLIFE),CUMPW
186 1(L+3,KLIFE)
187 30 FORMAT(7,I1,'TOTAL',T24,F13.2,T55,F13.2,T88,F13.2,T120,F13.2)
188 WRITE(6,16)
189 16 FORMAT(1H1,I3,'YEAR',T10,'PRESENT WORTH',T25,'CUMULATIVE',T39,'PRE
190 1SENT WORTH',T56,'CUMULATIVE',T71,'PRESENT WORTH',T89,'CUMULATIVE',
191 2T115,'AT',T24,'PRESENT WORTH',T44,'AT',T55,'PRESENT WORTH',T76,'A
192 3T118,'PRESENT WORTH',T111,'40 PERCENT',T24,'AT 40 PERCENT',T41
193 4,'45 PERCENT',T55,'AT 45 PERCENT',T72,'50 PERCENT',T88,'AT 50 PERC
194 5ENT',T114,'(44)',T28,'(45)',T43,'(46)',T59,'(47)',T76,'(48)',T92,
195 6'(49)',T113,'(27XDCF)',T42,'(27XDCF)',T74,'(27XDCF)',T12,'(YEARS
196 7)',T12,'(DOLLARS)',T26,'(DOLLARS)',T41,'(DOLLARS)',T57,'(DOLLARS
197 8)',T73,'(DOLLARS)',T90,'(DOLLARS)',T12,'(DOLLARS)',T10,'(DOLLARS)
198 9,T24,'(DOLLARS)',T39,'(DOLLARS)',T55,'(DOLLARS)',T71,'(DOLLARS)',
199 1'-----',T38,'(DOLLARS)',T155,'(DOLLARS)',T12,'(DOLLARS)',T71,'(DOLLARS)',
200 L = 8
201 DO 17 I=1,KLIFE
202 17 WRITE(6,18) YEAR(1),PW(L,1),CUMPW(L,1),FW(L+1,1),CUMPW(L+1,1),PW(L
203 1+2,1),CUMPW(L+2,1)
204 18 FORMAT(14,I2,T10,F13.2,T24,F13.2,T39,F13.2,T55,F13.2,T71,F13.2,T88
205 1,F13.2)
206 WRITE(6,31) CUMPW(L,KLIFE),CUMPW(L+1,KLIFE),CUMPW(L+2,KLIFE)
207 31 FORMAT(7,I1,'TOTAL',T24,F13.2,T55,F13.2,T88,F13.2,T120,F13.2)
208 IF(PR,LF,0.0) GO TO 20

```

```
209 WRITE(6,19) RR
210 FORMAT(1H0,T21,'THE RATE OF RETURN EQUALS ',FS.2,T53,'PERCENT.')
```

```
211 GO TO 22
212
213 20 WRITE(6,21)
214 21 FORMAT(1H0,T21,'(THE RATE OF RETURN IS GREATER THAN 50 PERCENT OR
215 115 EQUAL TO ZERO)')
216 22 RETURN
      END
```

```

1 C *****
2 C *****
3 C *****
4 C *****
5 C *****
6 C *****
7 C *****
8 C *****
9 C *****
10 C *****
11 C *****
12 C *****
13 C *****
14 C *****
15 C *****
16 C *****
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18 C *****
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31 C *****
32 C *****
33 C *****
34 C *****
35 C *****
36 C *****
37 C *****
38 C *****
39 C *****
40 C *****
41 C *****
42 C *****
43 C *****
44 C *****
45 C *****
46 C *****
47 C *****

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SURQCUTINE HEADINC (LOC,TODM,TODP,FIELD,PRODSAND,SIZE,SPACE,NIJW,N
1PROD,N,TDEPR,ADEPLA,CHEMI,PATTERN,MICELCST,POLYMCST,KLIFE,LIFTFACT,
2WATERIC,WATERDC,MICELIJC,POLYMIJC,GOPRODTC)
3CHARACTER LOC*30, FIELD*30,PRODSAND*30,CHEMI*30,ADEPLA*30,TDEPR*30,
41SPACE*11,PATTERN*11
5DIMENSION MICELCST(26),POLYMCST(26)
6REAL MICELCST,LIFTFACT,MICELIJC,MICELPRD
7INTEGER TODM,TODP,SIZE
8WRITE(6,250)
9250 FORMAT(1H1,T25,'TERTIARY OIL RECOVERY PROJECT',/T32,'ECONOMIC PROG
10RAM',/T37,'HEADING')
11WRITE(6,260) LOC,TODM,TODP,FIELD,PRODSAND,SIZE
12260 FORMAT(/T17,'LOCATION' . . . . . ,A30,/T17,'TYPE OF DIS
13PLACEMENT' . . . ,T2,'PERCENT MICELLAR AND ',T2,'PERCENT POLYM
14ER',/T17,'FIELD' . . . . . ,A30,/T17,'PRODUCING SAND
15RES')
16WRITE(6,270) SPACE,PATTERN,NIJW,NPROD,N,CHEMI,TDEPR,ADEPLA
17270 FORMAT (/T17,'SPACING' . . . . . ,A11,' SPOT',/T17,'NUMBER OF INJECTI
18TATERN' . . . . . ,A11,' SPOT',/T17,'NUMBER OF INJECTI
19ON WELLS' . . ,T4,/T17,'NUMBER OF PRODUCTION WELLS' . ,T4,/T17,C
20HEMICALS' . . . . . ,A30,/T17,'TYPE OF DEPRECIATION' .
21A30,/T17,'APPLY DEPLETION ALLOWANCE' . ,A30)
22WRITE(6,285)
23285 FORMAT(/T20,'MICELLAR SOLUTION COST',T53,'POLYMER COST',/T10,'C
241YEARS',T2,'(DOLLARS PER BARREL)',T50,'(DOLLARS PER BARREL)',/T10
25,T2,'T20',-----,T50,-----)
26DO 286 I=1,KLIFE
27286 WRITE(6,287) I,MICELCST(1),POLYMCST(1)
28287 FORMAT(T11,T2,T8,F6.3,T56,F6.3)
29WRITE(6,288)
30288 FORMAT(/T5,'LIFTING COST',T20,'WATER INJECTION',T38,'WATER DISC
311SAL',T55,'MICELLAR INJECTION',T76,'POLYMER INJECTION',T96,'GROSS O
32IL PRODUCTION',T18,'FACTOR',T26,'COST',T43,'COST',T62,'COST',T83,
33,'COST',T99,'TREATING COST',/T18,'$/BBL',T25,'$/BBL',T42,'$/BBL',T6
34,'COST',T82,'$/BBL',T103,'$/BBL',/T5,-----,T20,-----,
35T138,-----,T55,-----,T76,-----)
36WRITE(6,289) LIFTFACT,WATERIC,WATERDC,MICELIJC,POLYMIJC,GOPRODTC
37289 FORMAT(/T17,F8.4,T23,F8.4,T41,F8.4,T59,F8.4,T80,F8.4,T102,F8.4)
38RETURN
39END

```

```

1 C
2 C *****
3 C *****
4 C *****
5 C THIS SUBROUTINE WRITES OUT PRICE AS A FUNCTION OF DISCOUNTED CASH
6 C FLOW RATE
7 C *****
8 C *****
9 C *****
10 C SUBROUTINE WRITEOUT (RIPRICE)
11 C COMMON TANGI(26,5),CHEMCOST(26),DEPRSHUN(26),PLIFE,STALVAG,TOEP(2
12 C 16,5,26),CDEP(26,26),YCDEP(26),YEAR(26),GOPROD(26),LEASHCST(26),INT
13 C 2ANG(26),GACST(26),LIFTCTST(26),TANGIBLE(26),CHEMCST(26),RRR(10),RRP
14 C 3PRICE(10),EXPENCST(26),NOPROD(26),GINCOME(26),GIBTD(26),TICST(26)
15 C 4,NI4FSIT(26),PERDEPL(26),CSTDEPL(26),ALDEPL(26),NDEPI(26),PERCENTG
16 C 5(26),STAMORTS(26),TAXINC(26),STITAX(26),FEDTAXIN(26),FEDINTAX(26),
17 C 6NETCASHF(26),DCF(10,26),PW(10,26),CUMPW(10,26),RR,KLIFE,SNCF
18 C DIMENSION LABEL(14),RIPRICE(12)
19 C WRITE(6,1)
20 C 1 FORMAT(TH1,T25,'TERTIARY OIL RECOVERY PROJECT',/T32,'ECONOMIC PROG
21 C 1RAM',/T20,'PRICE AS A FUNCTION OF RATE OF RETURN',/T34,'* * *
22 C 2* * *',/T37,'RESULTS')
23 C WRITE(6,2)
24 C 2 FORMAT(/T20,'RATE OF RETURN',T48,'PRICE',/T20,'-----',
25 C 1T48,'-----')
26 C DO 3 I=1,10
27 C 3 WRITE(6,4) RRR(I),RIPRICE(I)
28 C 4 FORMAT(T24,F5.2,T47,F6.2)
29 C READ(5,5)(LABEL(J),J=1,14)
30 C 5 FORMAT(13A6,A2)
31 C CALL M15A (1,RRR,RIPRICE,10,,,LABEL)
32 C RETURN
33 C END

```

APPENDIX D

INPUT DATA AND CARD FORMATS

The input data and associated card formats necessary to run this program are described in this appendix. The number of data card sets can be limited and, therefore, control the program for different applications. If the data card is an array, care must be taken to input the correct number of data entries for each variable.

CARD 1.

N	PLIFE	EORECOV	LIFTFACT	WATERIC	WATERDC	MICELIJC	POLYMIJC	GOPRODTC	
I2	F5.2	F12.2	F6.3	F6.3	F6.3	F6.3	F6.3	F6.3	
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMNS</u>
N	YEARS OF PROJECT	I2	INTEGER	1-2
PLIFE	PROJECT LIFE, YRS.	F5.2	REAL	3-7
EORECOV	ESTIMATED OIL RE- COVERABLE, BBLs	F12.2	REAL	8-19
LIFTFACT	LIFTING FACTOR COST FOR FLUID PRODUCED, \$/BBL	F6.3	REAL	20-25
WATERIC	WATER INJECTION COSTS, \$/BBL	F6.3	REAL	26-31
WATERDC	WATER DISPOSAL COSTS, \$/BBL	F6.3	REAL	32-37
MICELIJC	MICELLAR INJECTION COST, \$/BBL	F6.3	REAL	38-43
POLYMIJC	POLYMER INJECTION COSTS, \$/BBL	F6.3	REAL	44-49
GOPRODTC	GROSS PRODUCTION TREATING COSTS, \$/BBL	F6.3	REAL	50-55

CARD 2. (A)*

YEAR(M)																									
26 12																									

<u>VARIABLE</u> <u>ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM</u> <u>FIELD</u>	<u>TYPE</u>	<u>COLUMNS</u>
YEAR(M)	YEAR OF RUN, YRS.	26I2	INTEGER	1-52

CARD/S 3. (A)*

GOPROD(M)																									
5F12.2																									

<u>VARIABLE</u> <u>ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM</u> <u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
GOPROD(M)	GROSS OIL PRODUCTION, BBLs	5F12.2	REAL	1-60

Goprod is production data obtained from decline curves or from a simulation model of the micellar process. Additional data cards are necessary if more than five years of production data are available. M represents the year of production.

CARD/S 4. (A)*

TANGI(J,L)																									
5F11.2																									

<u>VARIABLE</u> <u>ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM</u> <u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
TANGI(J,L)	TANGIBLE INVESTMENT, \$	5F11.2	REAL	1-55

*NOTE: Only (N-1) number of data entries are necessary for type (A) cards, but a maximum limit is 26.

CARD/S 7. (A)*

GACST (H)																																																																																																																																																																																																							
6710.2																																																																																																																																																																																																							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100																																																																																																				

<u>VARIABLE ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
GACST(M)	GENERAL AND ADMIN- ISTRATIVE COST, \$	6F10.2	REAL	1-60

M represents the year of the expense accredited to the total project and the maximum value of M is 26. GACST was calculated at \$70/well/month.

CARD/S 8. (A)*

WATERING (M)																																																																															
STUD 2																																																																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

<u>VARIABLE</u> <u>ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM</u> <u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
WATERINJ(M)	WATER INJECTION	6F10.2	REAL	1-60

M represents the year of the injection and has a maximum value of 26. Water injection is that quantity of water injected after the polymer solution.

CARD/S 9. (A)*

WATERPRD(M)																																																																																																																																																															
5210.2																																																																																																																																																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80																																																																																

<u>VARIABLE ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
WATERPRD(M)	WATER PRODUCTION FROM PRODUCTION WELLS	6F10.2	REAL	1-60

POLYMCST can be varied on an annual basis depending on the concentration. This is slightly curtailing, but does allow some flexibility. M is the year the cost applies and has a maximum value of 26.

CARD/S 15. (A)*

MICELQTY(M) 5F12.2																																																																																
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

<u>VARIABLE ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
MICELQTY(M)	MICELLAR QUANTITY INJECTED, BBLs	5F12.2	REAL	1-60

MICELQTY is the total amount of micellar solution that must be injected by design quantity of pore volume in any one year. M represents the year of injection and has a maximum value of 26. This data is obtained from a simulation model of the field being studied.

CARD/S 16. (A)*

POLYQTY (H) 5F12.2																																																																																
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

<u>VARIABLE ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
POLYMQTY(M)	POLYMER QUANTITY INJECTED, BBLs	5F12.2	REAL	1-60

POLYMQTY is the total amount of polymer that must be injected by design quantity of pore volume in any one year. M represents the year of injection and has a maximum value of 26. This data is

obtained from a simulation model of the field being studied.

CARD 17.

LOC A30																													

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
LOC	LOCATION OF THE FIELD	A30	CHARACTER	1-30

LOC is the location of the field being studied.

CARD 18.

FIELD A30																													

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
FIELD	NAME OF THE FIELD STUDIED	A-30	CHARACTER	1-30

Field is the name given to the producing area.

CARD 19.

PRODSAND A30																													

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
PRODSAND	PRODUCING SAND	A30	CHARACTER	1-30

PRODSAND is the name of the producing formation.

CARD 20.

[illegible]

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
SIZE	SIZE OF FIELD, ACRES	I10	INTEGER	1-10
TODM	TYPE OF DISPLACEMENT OF MICELLAR SOLUTION, %	I2	INTEGER	11-12
TODP	TYPE OF DISPLACEMENT OF POLYMER, %	I2	INTEGER	13-14
SPACE	TYPE OF WELL SPACING, ACRE	A11	CHARACTER	15-25
NIJW	NUMBER OF INJECTION WELLS	I4	INTEGER	26-27 ²⁹
NPROD	NUMBER OF PRODUC- TION WELLS	I4	INTEGER	28-29 ^{30 33}
PATTERN	LAYOUT OF THE WELLS	A11	CHARACTER	34-40 ^{34 44}

CARD TYPE (B)

These card sets must be arranged in the following order and are only used when the price code (PRICECD) is equal to 1. Duplicate sets of these data cards provide succeeding total runs of present worth profiles and must follow cards identified previously 1 - 20. A Type (B) data card set is made up of cards 21(B), 22(B), 23(B), 24(B) and 25(B).

CARD 21. (B)

DEPCODE	DEPLCODE	CHEM	PRICECD	PRICE
1	2	3	4	5

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
DEPCODE	DEPRECIATION CODE	I2	INTEGER	1-2
DEPLCODE	DEPLETION CODE	I2	INTEGER	3-4
CHEM	CHEMICAL CODE	I2	INTEGER	5-6
PRICECD	PRICE CODE	I2	INTEGER	7-8
PRICE	PRICE OF OIL SOLD, \$/BBL	F5.2	REAL	9-13

DEPCODE can be four numbers: a 1 calls subroutine SLD to calculate straight line depreciation, a 2 calls subroutine SYOD to calculate sum of the year's digits depreciation, a 3 calls subroutine DDB to calculate double declining balance depreciation, and a 4 calls subroutine DDBSL to calculate double declining balance with conversion to straight line depreciation.

DEPLCODE can be two numbers: a 1 applies an allowable depletion to the calculations and a 2 disregards depletion allowance.

CHEM can be two numbers: a 1 applies when chemicals (micellar and polymer) are expensed, and a 2 capitalizes the chemical investment.

PRICECD can be two numbers: a 1 applies to type (B) input cards and a 2 is only used when Type (C) data cards are inputted.

PRICE is the price that new oil can be sold.

CARD 22. (B)

CHEM
1

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
CHEMI	CHEMICALS ARE EXPENSED OR CAPITALIZED	A30	CHARACTER	1-30

CHEMI is used to output the name EXPENSED when CHEM is 1 on card 21(B) or CAPITALIZED when CHEM is 2 on card 21(B). The data should be either EXPENSED or CAPITALIZED.

CARD 23. (B)

ADEPLA A30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
ADEPLA	APPLICATION OF DEPLETION ALLOWANCE OR NOT	A30	CHARACTER	1-30

ADEPLA will be either YES or NO. YES when DEPLCODE is 1 on card 21(B) and NO when DEPLCODE is 2 on card 21(B).

CARD 24. (B)

TDEPR A30
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
TDEPR	TYPE OF DEPRECIATION	A30	CHARACTER	1-30

If DEPCODE on TYPE card 21(B) is 1, enter SLD for TDEPR, a 2 enter SYOD for TDEPR, a 3 enter DDB for TDEPR or a 4 enter DDBSL for TDEPR.

CARD 25. (B)

<div> <div>LABEL</div> <div>13A6,A2</div> </div>									
1	2	3	4	5	6	7	8	9	10

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
LABEL	IS THE LABEL FOR THE PLOT OF DIS- COUNT FACTOR VS. PRESENT VALUE	13A6,A2	CHARACTER	1-8

Input for LABEL is PRESENT VALUE (Dollars) VERSUS DISCOUNT RATE (PERCENT).

CARD TYPE (C)

These data cards sets must be arranged in the following order and are only used when the price code (PRICECD) is equal to 2. Duplicate sets of these data cards provide succeeding total runs of price determination as a function of rate of return within a tolerance of .1. This tolerance can be lowered if a greater accuracy is desired.

CARD 26. (C)

DEPCODE	DEPLCODE	CHEM	PRICECD	PRICE
1	2	3	4	5

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
DEPCODE	DEPRECIATION CODE	I2	INTEGER	1-2
DEPLCODE	DEPLETION CODE	I2	INTEGER	3-4
CHEM	CHEMICAL CODE	I2	INTEGER	5-6
PRICECD	PRICE CODE	I2	INTEGER	7-8
PRICE	PRICE OF OIL SOLD, \$/BBL	F5.2	REAL	9-13

DEPCODE can be four numbers: a 1 calls subroutine SLD to calculate straight line depreciation, a 2 calls subroutine SYOD to calculate sum of the year's digits depreciation, a 3 calls subroutine DDB to calculate double declining balance depreciation, and a 4 calls subroutine DDBSL to calculate double declining balance with conversion to straight line depreciation.

DEPLCODE can be two numbers: a 1 applies an allowable depletion to the calculations and a 2 disregards depletion allowance.

CHEM can be two numbers: a 1 applies when chemicals (micellar and polymer) are expensed and a 2 capitalizes the chemical investment.

PRICECD can be two numbers: a 1 applies to type (B) input cards and a 2 is only used when Type (C) data cards are used. Enter any dummy value in the field for PRICE. It is not used with this data.

CARD 27. (C)

CHEM A30																													

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
CHEMI	CHEMICALS ARE EXPENSED OR CAPITALIZED	A30	CHARACTER	1-30

CHEMI is used to output the name EXPENSED when CHEM is 1 on card 26(C) or CAPITALIZED when CHEM is 2 on card 26(C). The data should be either EXPENSED or CAPITALIZED.

CARD 28. (C)

ADEPLA A30																																																																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
ADEPLA	APPLICATION OF DE- PLETION ALLOWANCE OR NOT	A30	CHARACTER	1-30

ADEPLA will be either YES or NO. Input is YES when DEPLCODE is 1 on card 26(C) and NO when DEPLCODE is 2 on card 26(C).

CARD 29. (C)

TDEPR A30																																																																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
TDEPR	TYPE OF DEPRECIATION	A30	CHARACTER	1-30

If DEPCODE on type card 26(C) is 1, enter SLD for TDEPR, a 2 enter SYOD for TDEPR, a 3 enter DDB for TDEPR or a 4 enter DDBSL for TDEPR.

CARD 30. (C)

RRR(K) 10F5.2																																																																															
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80

<u>VARIABLE</u>	<u>DESCRIPTION</u>	<u>MAXIMUM</u> <u>FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
RRR(K)	READ IN VALUE OF RATE OF RETURN	10F5.2	REAL	1-50

RRR values can be any number between 0.00 and 50.00 and K has a maximum value of 10.

CARD 31. (C)

LABEL 13A6,A2									
1	2	3	4	5	6	7	8	9	10
11	12	13	14	15	16	17	18	19	20
21	22	23	24	25	26	27	28	29	30
31	32	33	34	35	36	37	38	39	40
41	42	43	44	45	46	47	48	49	50
51	52	53	54	55	56	57	58	59	60
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

<u>VARIABLE ARRAY</u>	<u>DESCRIPTION</u>	<u>MAXIMUM FIELD</u>	<u>TYPE</u>	<u>COLUMN</u>
LABEL	IS THE LABEL FOR THE PLOT OF PRICE (DOLLAR) VERSUS RATE OF RETURN (PERCENT)	13A6,A2	CHARACTER	1-8

Input data for LABEL is PRICE (DOLLARS) VERSUS RATE OF RETURN (PERCENT). The read statement is in subroutine WRITEOUT.

It should be understood that data sets type (B) or (C) can be put in any combination sequential order, but at least one type set must be in the data input.

APPENDIX E

TERTIARY OIL RECOVERY PROJECT

October 21, 1974
Outline of Project Work

I. Assessment of Resource

Neal Plocek
Jim Aber
Bill Hulse

1. Initial Screening of Fields
(January 1, 1975)

- a. Bibliography of available information on Kansas Oil Fields (November 15, 1974)
- b. Summarize data of D. Beene and other available information.
Classify fields by formation type.

2. Verification of data

- a. M. Oros file
- b. Data from industry

3. Estimated Recoveries by Primary and Secondary Production - to calculate tertiary oil possibilities.
(First Report by June 30, 1975)4. "First pass" estimates of recoveries by Tertiary Oil Recovery Techniques
(First Report by June 30, 1975)

5. Selection of representative reservoirs for more detailed analyses

- a. Detailed reservoir estimates of recovery
- b. Economic calculations
- c. Perhaps recovery as f (oil price)

II. T.O.R. Laboratory

Bill Kritikos
Jose Dominguez
David Zornes
Milfred Mast

1. Establishment of laboratory for physical property measurement (June 30, 1975)

- a. Permeability
- b. Porosity

- c. Capillary Pressure
- d. Relative Permeability
- e. Oil Viscosity
- f. Oil Density
- g. Surface Tension
- h. Interfacial Tension
(* Decision needs to be made as to equipment type)
- i. Water Characteristics (Geological Survey)

Composition of salt,
Conductivity, and
Di-valent and tri-valent ions

APPENDIX F

TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

* * * * *

HEADING

LOCATION SOUTH CENTRAL BUTLER CO., KS.
TYPE OF DISPLACEMENT 8 PERCENT MICELLAR AND 70 PERCENT POLYMER
FIELD FL DORADO
PRODUCING SAND EL DORADO SHALLOW (ADMIRE)
SIZE 650 ACRES
SPACING 5 ACRES
PATTERN INVERTED 5 SPOT
NUMBER OF INJECTION WELLS 128
NUMBER OF PRODUCTION WELLS 153
CHEMICALS EXPENSED
TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
APPLY DEFLECTION ALLOWANCE NO

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)
1	8.500	0.280
2	8.500	0.280
3	8.500	0.175
4	8.500	0.070
5	8.500	0.070
6	8.500	0.070
7	8.500	0.070
8	8.500	0.070

LIFTING COST FACTOR \$/HBL	WATER INJECTION COST \$/HBL	WATER DISPOSAL COST \$/HBL	MICELLAR INJECTION COST \$/HBL	POLYMER INJECTION COST \$/HBL	GROSS OIL PRODUCTION TREATING COST \$/HBL
0.0320	0.0260	0.0260	0.1840	0.0410	0.4150

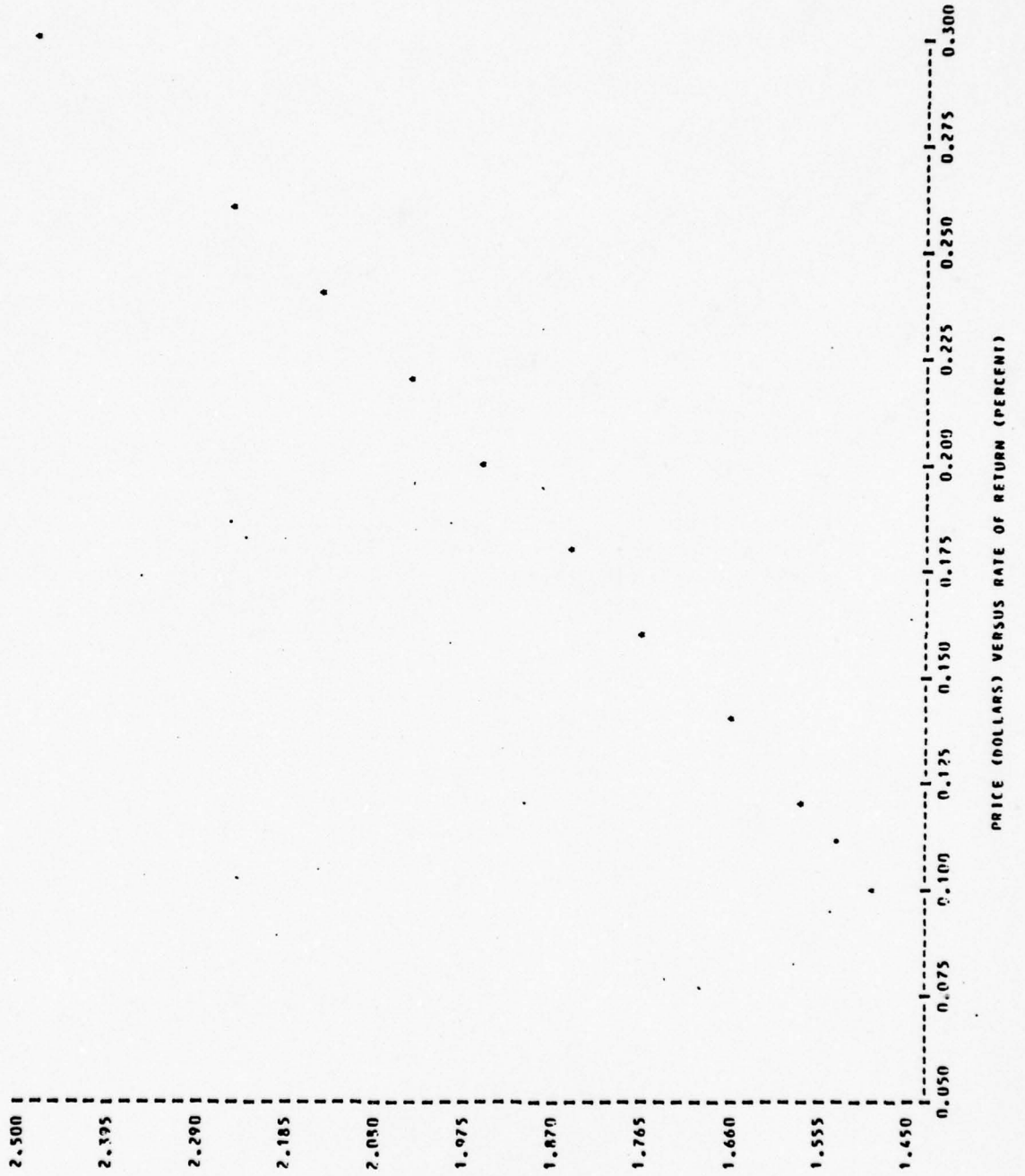
TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

PRICE AS A FUNCTION OF RATE OF RETURN

* * * * *

RESULTS

RATE OF RETURN	PRICE
10.00	14.97
12.00	15.79
14.00	16.65
16.00	17.57
18.00	18.48
20.00	19.51
22.00	20.43
24.00	21.41
26.00	22.55
30.00	24.80



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

HEADING

LOCATION SOUTH CENTRAL BUTLER CO., KS.
TYPE OF DISPLACEMENT 3 PERCENT MICELLAR AND 70 PERCENT POLYMER
FIELD EL DORADO
PRODUCING SAND EL DORADO SHALLOW (ADMIRE)
SIZE 650 ACRES
SPACING 5 ACRES
PATTERN INVERTED 5 SPOT
NUMBER OF INJECTION WELLS 128
NUMBER OF PRODUCTION WELLS 153
CHEMICALS CAPITALIZED
TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
APPLY DEPLETION ALLOWANCE NO

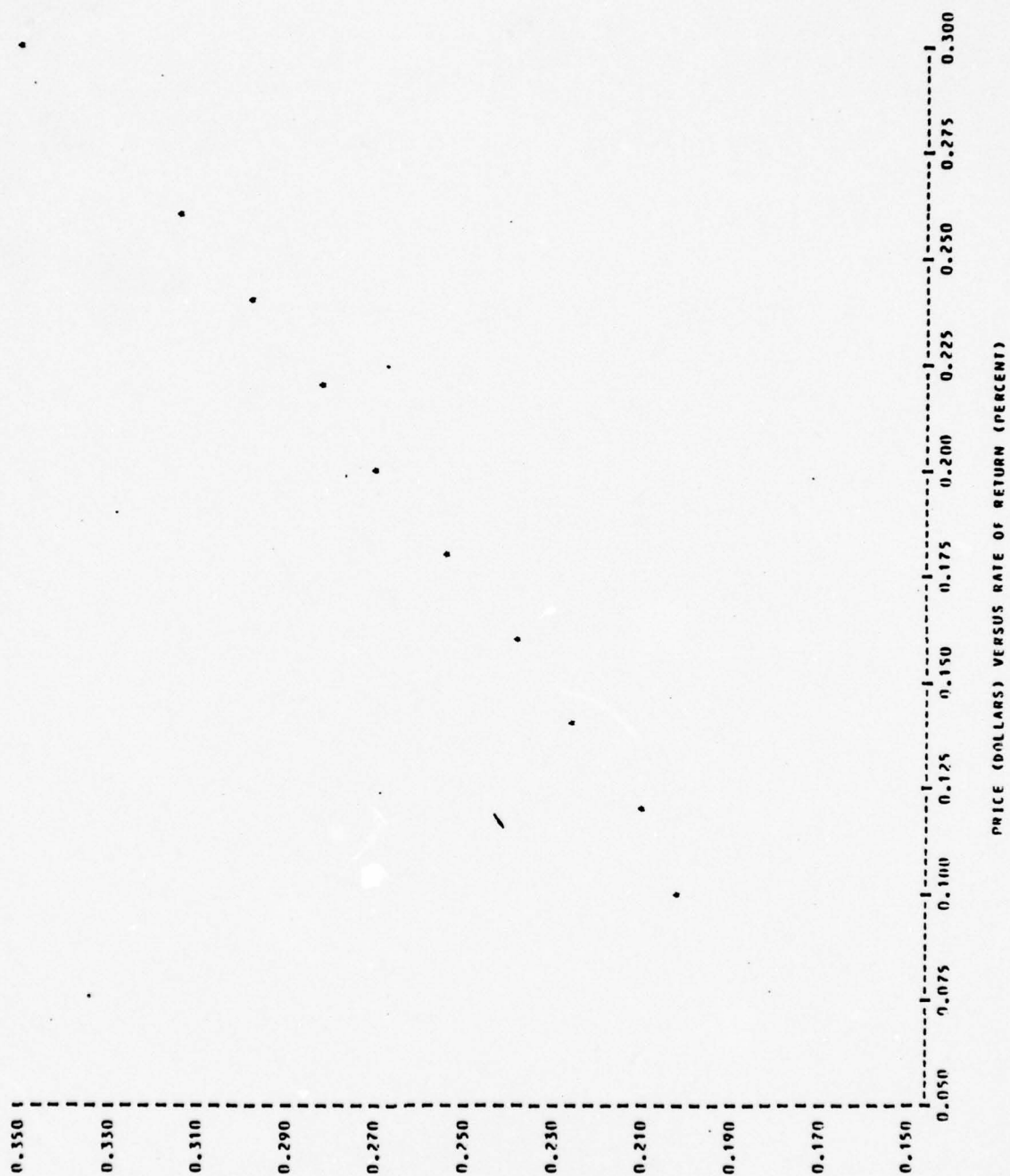
(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)	WATER INJECTION COST \$/BBL	WATER DISPOSAL COST \$/BBL	MICELLAR INJECTION COST \$/BBL	POLYMER INJECTION COST \$/BBL	GROSS OIL PRODUCTION TREATING COST \$/BBL
1	8.500	0.280					
2	8.500	0.280					
3	8.500	0.175					
4	8.500	0.070					
5	8.500	0.070					
6	8.500	0.070					
7	8.500	0.070					
8	8.500	0.070					
LIFTING COST FACTOR 1/PH	0.0260		0.0260	0.0260	0.1840	0.0410	0.4150

TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

PRICE AS A FUNCTION OF RATE OF RETURN

RESULTS

RATE OF RETURN	PRICE
10.00	20.00
12.00	21.12
14.00	22.49
16.00	23.93
18.00	25.27
20.00	26.92
22.00	28.30
24.00	29.87
26.00	31.57
30.00	34.92



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

HEADING

LOCATION SOUTH CENTRAL HUILE CO., KS.
TYPE OF DISPLACEMENT 8 PERCENT MICELLAR AND 70 PERCENT POLYMER
FIELD EL DORADO
PRODUCING SAND EL DORADO SHALLOW (ADHIRE)
SIZE 450 ACRES
SPACING 5 ACRES
PATTERN INVERTED 5 SPOT
NUMBER OF INJECTION WELLS 128
NUMBER OF PRODUCTION WELLS 153
CHEMICALS EXPENSED
TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
APPLY DEPLETION ALLOWANCE YES

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)	WATER INJECTION COST \$/HBL	WATER DISPOSAL COST \$/HBL	MICELLAR INJECTION COST \$/HBL	POLYMER INJECTION COST \$/HBL	GROSS OIL PRODUCTION TREATING COST \$/HBL
1	8.500	0.280					
2	8.500	0.280					
3	8.500	0.175					
4	8.500	0.070					
5	8.500	0.070					
6	8.500	0.070					
7	8.500	0.070					
8	8.500	0.070					
0.0320	0.0260	0.0260	0.0260	0.1940	0.0410	0.4150	

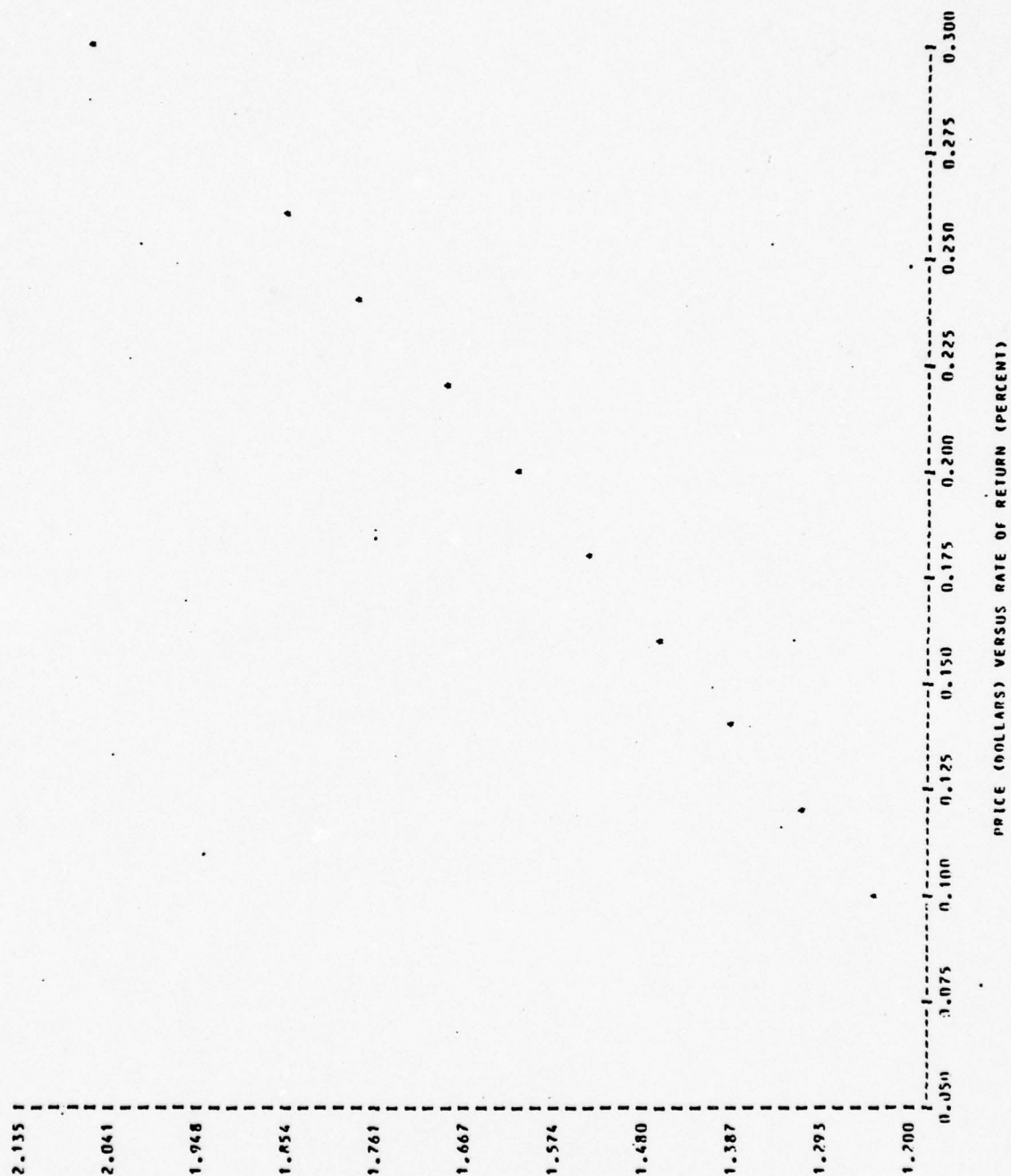
TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

PRICE AS A FUNCTION OF RATE OF RETURN

* * * * *

RESULTS

RATE OF RETURN	PRICE
10.00	12.37
12.00	13.04
14.00	13.78
16.00	14.53
18.00	15.30
20.00	16.12
22.00	16.91
24.00	17.77
26.00	18.62
30.00	20.54



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

HEADING

LOCATION SOUTH CENTRAL BUTLER CO., KS.
TYPE OF DISPLACEMENT 8 PERCENT MICELLAR AND 70 PERCENT POLYMER
FIELD EL DORADO
PRODUCING SAND EL DORADO SHALLOW (AD-MIRE)
SIZE 650 ACRES
SPACING 5 ACRES
PATTERN INVERTED 5 SPOT
NUMBER OF INJECTION WELLS . . . 128
NUMBER OF PRODUCTION WELLS . . 153
CHEMICALS CAPITALIZED
TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
APPLY DEPLETION ALLOWANCE . . . YES

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)	WATER INJECTION COST \$/BBL	WATER DISPOSAL COST \$/BBL	MICELLAR INJECTION COST \$/BBL	POLYMER INJECTION COST \$/BBL	GROSS OIL PRODUCTION TREATING COST \$/BBL
1	8,500	1,280					
2	8,500	0,280					
3	8,500	0,175					
4	8,500	0,070					
5	8,500	0,070					
6	8,500	0,070					
7	8,500	0,070					
8	8,500	0,070					
LIFTING COST FACTOR 1/BPL	0.0320	0.0260	0.0260	0.1840	0.0410	0.4150	

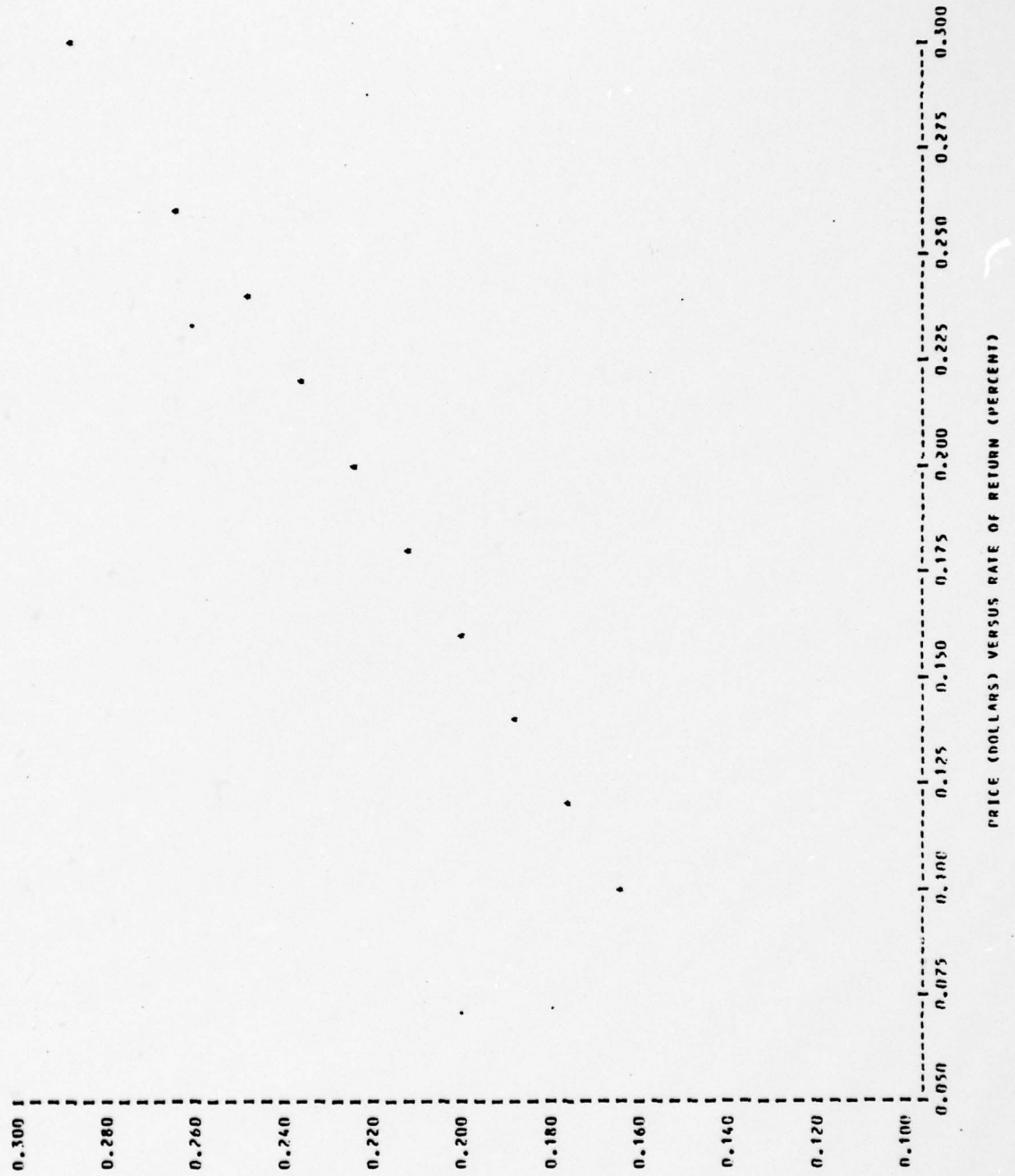
TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

PRICE AS A FUNCTION OF RATE OF RETURN

* * * * *

RESULTS

RATE OF RETURN	PRICE
10.00	16.55
12.00	17.52
14.00	18.73
16.00	19.85
18.00	21.00
20.00	22.34
22.00	23.50
24.00	24.79
26.00	26.24
30.00	28.99



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

SUMMARY

LOCATION SOUTH CENTRAL BUTLER CO., KS.
TYPE OF DISPLACEMENT 8 PERCENT MICELLAR AND 70 PERCENT POLYMER
FIELD FL DORADO
PRODUCING SAND EL DORADO SHALLOW (ADMIRE)
SIZE 650 ACRES
SPACING 5 ACRES
PATTERN INVERTED 5 SPOT
NUMBER OF INJECTION WELLS 128
NUMBER OF PRODUCTION WELLS 153
PRICE OF OIL 14.00 DOLLARS
RATE OF RETURN 6.98 PERCENT
CHEMICALS CAPITALIZED
TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
APPLY DEPLETION ALLOWANCE YES

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)
1	9.500	0.230
2	8.500	0.280
3	8.500	0.175
4	8.500	0.070
5	8.500	0.070
6	9.500	0.070
7	9.500	0.070
8	8.500	3.070

LIFTING COST FACTOR \$/BBL	WATER INJECTION COST \$/BBL	LATER DISPOSAL COST \$/BBL	MICELLAR INJECTION COST \$/BBL	POLYMER INJECTION COST \$/BBL	GROSS OIL PRODUCTION TREATING COST \$/BBL
0.0520	0.0209	0.0260	0.1840	0.0610	0.4150

TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

RESULTS

YEAR (YEARS) (1)	GROSS OIL PRODUCTION (BARRELS) (2)	NET OIL PRODUCTION (BARRELS) (3)	PRICE(X3) (7/XX2)	GROSS INCOME (DOLLARS) (4)	INTANGIBLE COST (DOLLARS) (5)	CHEMICAL COST (DOLLARS) (6)	LIFTING COST (DOLLARS) (7)	GENERAL AND ADMIN COST (DOLLARS) (8)	EXPENSED COST (DOLLARS) (9)
1	0.	0.	0.	0.	2301390.00	0.	0.	236040.00	2537430.00
2	0.	0.	0.	0.	87750.00	0.	867287.98	236040.00	1191077.98
3	93770.88	82049.52	0.	1148693.28	175500.00	0.	495641.44	236040.00	907181.44
4	904078.08	791068.32	0.	11074956.50	117000.00	0.	481338.24	236040.00	834378.24
5	1159918.08	1014928.32	0.	14208996.50	87750.00	0.	922550.98	236040.00	1246340.98
6	624076.80	546067.20	0.	7644940.75	58500.00	0.	558611.24	236040.00	833151.24
7	274885.12	240524.48	0.	3367342.72	29250.00	0.	387701.34	236040.00	652991.35
8	90626.56	79298.24	0.	1110175.34	29250.00	0.	133501.48	236040.00	398791.48
SUB TOTAL	3147355.53	2753936.09		38555105.00	2886390.00	0.	3846632.91	1888320.00	8621343.00

YEAR (YEARS) (1)	GROSS INCOME BEFORE TAX AND DEPL AND DEPR (DOLLARS) (10)	CAPITALIZED CHEMICAL COST (DOLLARS) (11)	TANGIBLE INVESTMENT COST (DOLLARS) (12)	NET TANGIBLE INVESTMENT MINUS SALVAGE (DOLLARS) (13)	DEPRECIATION SL/XYOD/DOB (DOLLARS) (14)	NET INCOME BEFORE STATE AND FED TAXES (DOLLARS) (15)	65 PERCENT OF NET INCOME BSFT (DOLLARS) (16)	22 PERCENT OF GROSS INCOME (DOLLARS) (17)
1	-2537430.00	0.	2798110.00	2798110.00	721960.66	-3259390.66	-2118603.91	0.
2	-1191077.98	17907387.50	0.	17907387.50	2035162.42	-3226240.41	-2097056.27	0.
3	241511.84	884753.19	0.	884753.19	1971968.70	-1230456.86	-1124796.95	252712.52
4	10240578.25	373581.02	0.	373581.02	1945814.30	8294783.94	5391596.56	2336490.44
5	12962655.50	208794.07	0.	208794.07	1956589.23	11006066.25	7153943.06	3125979.25
6	6791789.50	0.	0.	0.	1797425.94	4994363.56	3246336.31	1681886.97
7	2714351.19	0.	0.	0.	1788671.75	925679.44	601691.63	740815.40
8	711383.87	0.	0.	-506700.88	1780937.86	-1069544.00	-695210.10	244238.58
SUB TOTAL	2993762.25	19374515.75	2798110.00	21665924.75	15998331.00	15935231.25	10357900.38	8482123.25

YEAR	PERCENT DEPLETION (18)	LEASEHOLD COST (19)	COST DEPLETION (20)	ALLOWABLE DEPLETION (21)	STATE AMORTIZATION (22)	TAXABLE INCOME (23)	STATE INCOME TAX (24)	FEDERAL TAXABLE INCOME (25)	FEDERAL INCOME TAX (26)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(GREATER (18 OR 20) (DOLLARS)	(13/2.0) (+ CARRY FWD) (DOLLARS)	(10-22) (DOLLARS)	(24) (DOLLARS)	(15-12-24) (DOLLARS)	(26) (DOLLARS)
1	0.	0.	0.	0.	139055.00	-193685.00	-177141.82	-3082248.84	-1479479.45
2	0.	0.	0.	0.	10332748.75	11543826.75	-519472.20	-2706768.22	-1299248.75
3	0.	0.	0.	0.	9396070.38	-9154558.50	-411953.13	-1318501.73	-632880.84
4	2436490.44	0.	0.	2436490.44	629167.10	961141.13	648207.75	5210065.75	2500831.56
5	3125979.25	0.	0.	3125979.25	291182.55	12671468.00	854761.59	7025325.44	3372156.22
6	1681886.97	0.	0.	1681886.97	104397.04	6687392.44	450836.49	2861640.09	1373587.25
7	601691.63	0.	0.	601691.63	0.	2714351.19	182656.21	141331.60	67839.17
8	0.	0.	0.	0.	-253350.44	964734.31	64557.07	-1134111.06	-544373.31
SUB TOTAL	7846048.31	0.	0.	7846048.31	21919275.25	3014486.81	1092449.92	6996733.06	3358431.81

YEAR	NET CASH FLOW (27)	DISCOUNT FACTOR AT 5 PERCENT (28)	PRESENT WORTH AT 5 PERCENT (29)	CUMULATIVE PRESENT WORTH AT 5 PERCENT (30)	PRESENT WORTH AT 10 PERCENT (31)	CUMULATIVE PRESENT WORTH AT 10 PERCENT (32)	PRESENT WORTH AT 15 PERCENT (33)	CUMULATIVE PRESENT WORTH AT 15 PERCENT (34)
(YEARS)	(DOLLARS)	(PERCENT)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3678918.72	0.952381	-3503732.13	-3503732.13	-3344471.59	-3344471.59	-3199059.72	-3199059.72
2	-17279744.50	0.907029	-15673237.50	-19176969.75	-14280780.75	-17625252.25	-13065969.25	-16265029.00
3	401594.63	0.863838	346912.54	-18830057.25	301723.99	-17323328.25	264054.98	-16000974.00
4	6717957.94	0.822702	5526886.69	-13303126.63	4588455.75	-12735072.50	3841014.19	-12159959.88
5	8526943.63	0.783526	6681083.50	-6622093.13	5294561.25	-7440311.25	4239397.88	-7920562.00
6	4967365.75	0.746215	3706724.84	-2915368.28	2803948.53	-4636362.75	2147529.22	-5773032.81
7	2463855.81	0.710681	1751016.34	-1164351.94	1264347.66	-3372215.09	926254.62	-4846778.19
8	1427901.00	0.676839	1149206.25	-15145.69	792083.38	-2580131.72	555046.83	-4291731.38
TOTAL	3816955.31			-15145.69		-2580131.72		-4291731.38

YEAR	PRESENT NORTH AT 20 PERCENT (36)	CUMULATIVE PRESENT NORTH AT 20 PERCENT (37)	PRESENT NORTH AT 25 PERCENT (38)	CUMULATIVE PRESENT NORTH AT 25 PERCENT (39)	PRESENT NORTH AT 30 PERCENT (40)	CUMULATIVE PRESENT NORTH AT 30 PERCENT (41)	PRESENT NORTH AT 35 PERCENT (42)	CUMULATIVE PRESENT NORTH AT 35 PERCENT (43)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3065765.59	-3065765.59	-2943134.97	-2943134.97	-2829937.47	-2829937.47	-2725125.00	-2725125.00
2	-11998822.50	-15065588.13	-11059036.50	-14002171.50	-10224700.88	-13054638.38	-9481341.25	-12206466.25
3	232404.30	-14833183.88	205616.45	-13796555.00	182792.27	-12871846.13	163224.97	-12043241.25
4	3239255.91	-11593428.00	2751675.56	-11044879.50	2352143.81	-10519702.38	2022563.72	-10020677.50
5	3426787.31	-8166640.69	2794102.88	-8250770.63	2296553.88	-8223148.50	1901623.61	-8119035.88
6	1663560.70	-6503080.00	1302165.13	-6948603.50	1029120.02	-7194028.50	820584.94	-7298468.94
7	687616.93	-5815463.06	516702.02	-6431892.50	392655.63	-6801372.88	301494.17	-6996974.75
8	394877.50	-5420585.56	284866.52	-6147037.00	208144.79	-6593228.06	153901.28	-6843075.56
TOTAL		-5420585.56		-6147037.00		-6593228.06		-6843075.56

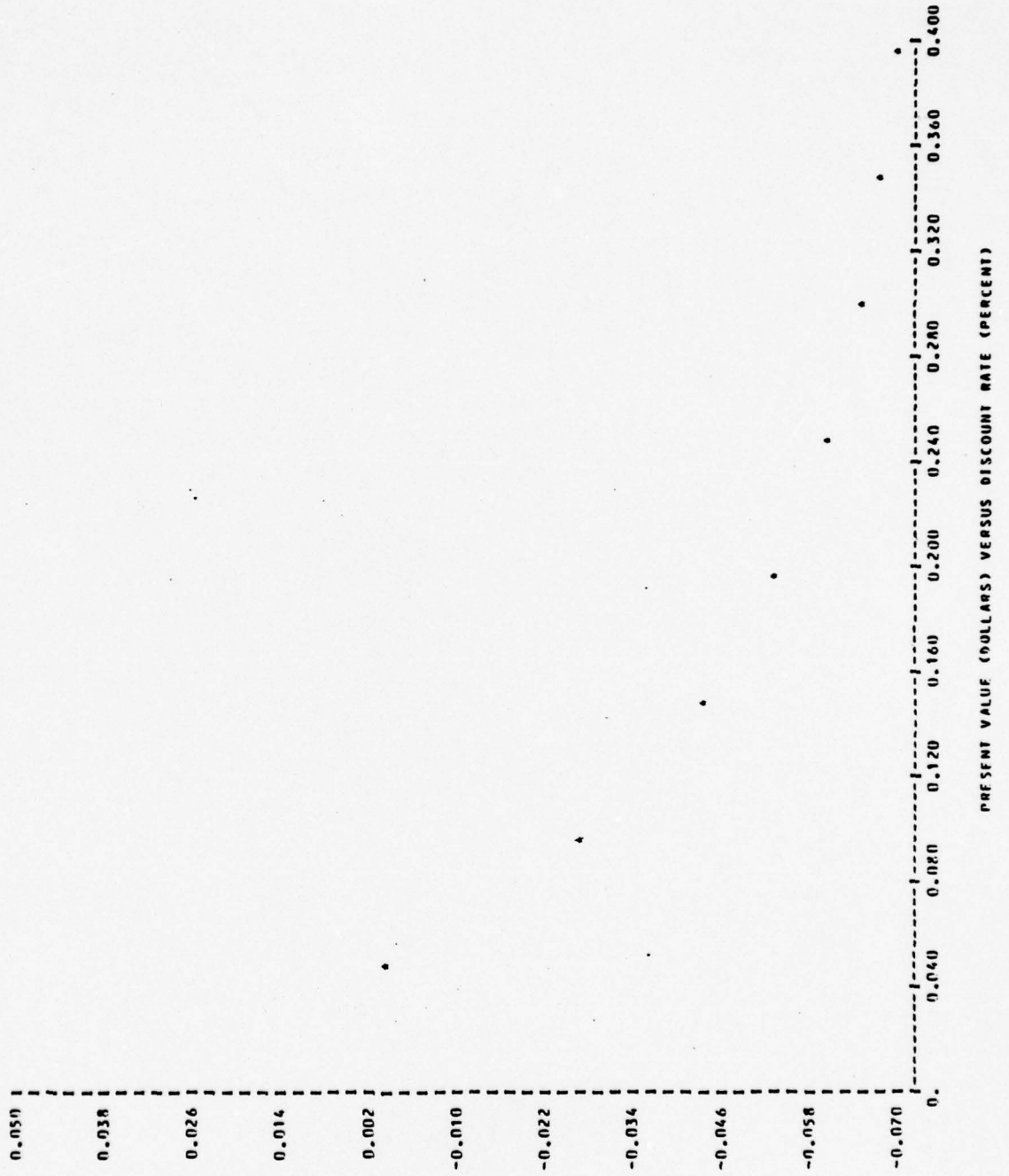
YEAR	PRESENT NORTH AT 40 PERCENT (44)	CUMULATIVE PRESENT NORTH AT 40 PERCENT (45)	PRESENT NORTH AT 45 PERCENT (46)	CUMULATIVE PRESENT NORTH AT 45 PERCENT (47)	PRESENT NORTH AT 50 PERCENT (48)	CUMULATIVE PRESENT NORTH AT 50 PERCENT (49)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-2627799.06	-2627799.06	-2537185.31	-2537185.31	-2452612.47	-2452612.47
2	-8816196.13	-11443995.25	-8218665.56	-10755850.88	-7679886.44	-10132498.88
3	146353.72	-11297641.50	131725.76	-10624121.13	118991.00	-10013507.88
4	1748739.53	-9548902.00	1519725.91	-9104395.25	1327004.03	-8686503.88
5	1585452.38	-7963449.63	1310311.59	-7774083.69	1122889.69	-7563614.19
6	659217.35	-7303732.25	534463.58	-7239620.13	436092.46	-7127521.75
7	233732.46	-7069999.81	182826.55	-7056793.56	144203.72	-6983318.00
8	115050.38	-6954949.44	86885.71	-6969903.88	66249.45	-6917068.56
TOTAL		-6954949.44		-6969903.88		-6917068.56

THE RATE OF RETURN EQUALS 4.98 PERCENT.

YEAR	PRESENT WORTH AT 20 PERCENT (36)	CUMULATIVE PRESENT WORTH AT 20 PERCENT (37)	PRESENT WORTH AT 25 PERCENT (38)	CUMULATIVE PRESENT WORTH AT 25 PERCENT (39)	PRESENT WORTH AT 30 PERCENT (40)	CUMULATIVE PRESENT WORTH AT 30 PERCENT (41)	PRESENT WORTH AT 35 PERCENT (42)	CUMULATIVE PRESENT WORTH AT 35 PERCENT (43)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3065765.59	-3065765.59	-2943134.97	-2943134.97	-2829937.47	-2829937.47	-2725125.00	-2725125.00
2	-11999822.50	-15065588.13	-11059032.50	-14002171.50	-10224700.88	-13054638.38	-9481341.25	-12206466.25
3	232404.30	-14833183.88	205616.45	-13796555.00	182792.27	-12871846.13	163224.97	-12043241.25
4	3239755.91	-11593428.00	2751675.56	-11044879.50	2352143.81	-10519702.38	2022563.72	-10020477.50
5	3426787.31	-8166640.69	2794102.88	-8250770.63	2296553.88	-8223148.50	1901623.61	-8119053.88
6	1663560.70	-6503080.00	1302165.13	-6948605.50	1029120.02	-7194028.50	820584.94	-7298468.94
7	687616.93	-5815463.06	516702.02	-6431897.50	392655.63	-6801372.88	301494.17	-6996974.75
8	394877.50	-5420585.56	284860.52	-6147037.00	208144.79	-6593228.06	153901.28	-6843073.50
TOTAL		-5420585.56		-6147037.00		-6593228.06		-6843073.50

YEAR	PRESENT WORTH AT 40 PERCENT (44)	CUMULATIVE PRESENT WORTH AT 40 PERCENT (45)	PRESENT WORTH AT 45 PERCENT (46)	CUMULATIVE PRESENT WORTH AT 45 PERCENT (47)	PRESENT WORTH AT 50 PERCENT (48)	CUMULATIVE PRESENT WORTH AT 50 PERCENT (49)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-2627799.06	-2627799.06	-2537185.31	-2537185.31	-2452612.47	-2452612.47
2	-8816196.13	-11443995.25	-8218665.56	-10755850.88	-7679886.44	-10132498.88
3	146353.72	-11297641.50	131729.76	-10624121.13	118991.00	-10013507.88
4	1748739.53	-9548902.00	151925.91	-9104395.25	1327004.03	-8686503.88
5	1585452.38	-7963449.63	1330311.59	-7774083.69	1122889.69	-7563614.19
6	659717.35	-7303732.25	534663.58	-7239620.13	436092.46	-7127521.75
7	233732.46	-7069999.81	182824.55	-7056793.56	144203.72	-6983318.00
8	115050.38	-6954949.44	86885.71	-6969903.88	66249.45	-6917068.56
TOTAL		-6954949.44		-6969903.88		-6917068.56

THE RATE OF RETURN EQUALS 4.98 PERCENT.



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

SUMMARY

LOCATION SOUTH CENTRAL HUTLER CO., KS.
TYPE OF DISPLACEMENT 8 PERCENT MICELLAR AND 70 PERCENT POLYMER
FIELD EL DORADO
PRODUCING SAND FL-DORADO SHALLOW (ADMIRE)
SIZE 650 ACRES
SPACING 5 ACRES
PATTERN INVERTED 5 SPOT
NUMBER OF INJECTION WELLS . . . 128
NUMBER OF PRODUCTION WELLS . . 153
PRICE OF OIL 14.00 DOLLARS
RATE OF RETURN 7.76 PERCENT
CHEMICALS EXPENSED
TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
APPLY DEPLETION ALLOWANCE . . . NO

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)	WATER INJECTION COST \$/BBL	WATER DISPOSAL COST \$/BBL	MICELLAR INJECTION COST \$/BBL	POLYMER INJECTION COST \$/BBL	GROSS OIL PRODUCTION TREATING COST \$/BBL
1	8.500	0.280					
2	8.500	0.280					
3	8.500	0.175					
4	8.500	0.070					
5	8.500	0.070					
6	8.500	0.070					
7	8.500	0.070					
8	8.500	0.070					
0.0320	0.0260	0.1840	0.0250		0.0410		0.4150

TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

RESULTS

YEAR (YEARS) (1)	GROSS OIL PRODUCTION (BARRELS) (2)	NET OIL PRODUCTION (BARRELS) (3)	PRICE(3) (7/RX2)	GROSS INCOME (DOLLARS) (4)	INTANGIBLE COST (DOLLARS) (5)	CHEMICAL COST (DOLLARS) (6)	LIFTING COST (DOLLARS) (7)	GENERAL AND ADMIN COST (DOLLARS) (8)	EXPENSED COST (DOLLARS) (9)
1	0.	0.	0.	0.	2301390.00	0.	0.	236040.00	(5+6+7+8)
2	0.	0.	0.	0.	87750.00	17907387.50	867287.98	236040.00	2537430.00
3	93770.88	82049.52	0.	1148693.28	175500.00	884753.19	495641.44	236040.00	19098465.50
4	904078.08	791068.52	0.	11074936.50	117000.00	373581.02	481338.24	236040.00	1791934.63
5	1159918.08	1014928.52	0.	14208996.50	87750.00	208794.07	923550.98	236040.00	1207959.27
6	624076.00	546067.20	0.	7644940.75	58500.00	0.	558611.24	236040.00	1455135.06
7	274885.12	240524.48	0.	3367342.72	29250.00	0.	387701.54	236040.00	853151.24
8	90626.56	79298.24	0.	1116175.34	29250.00	0.	133501.48	236040.00	652991.55
SUR TOTAL	3147555.53	2753956.09	0.	58555105.00	2886390.00	19374515.75	3846632.91	1888320.00	27993858.75

YEAR (YEARS)	GROSS INCOME BEFORE TAX AND DEPL AND DEPR (DOLLARS) (10)	TANGIBLE INVESTMENT COST (DOLLARS) (12)	NET TANGIBLE INVESTMENT MINUS SALVAGE (DOLLARS) (13)	DEPRECIATION SL/STOOD/DDH DDBSL (DOLLARS) (14)	NET INCOME BEFORE STATE AND FED TAXES (DOLLARS) (15)	65 PERCENT OF NET INCOME DSFT (DOLLARS) (16)	22 PERCENT OF GROSS INCOME (DOLLARS) (17)
1	-2537430.00	2798110.00	2798110.00	721960.66	-3259390.66	0.	0.
2	-19098465.50	0.	0.	481349.18	19579814.75	0.	0.
3	-643241.34	0.	0.	330772.41	-974013.76	0.	0.
4	9866997.25	0.	0.	264271.27	9602726.00	0.	0.
5	12753861.50	0.	0.	248946.93	12504914.63	0.	0.
6	6701789.50	0.	0.	89283.65	6702055.88	0.	0.
7	2714351.19	0.	0.	81029.46	2633321.72	0.	0.
8	711335.87	0.	-506700.88	73295.56	638088.31	0.	0.
SUR TOTAL	10559246.63	2798110.00	2291409.13	2291409.16	8267837.31	0.	0.

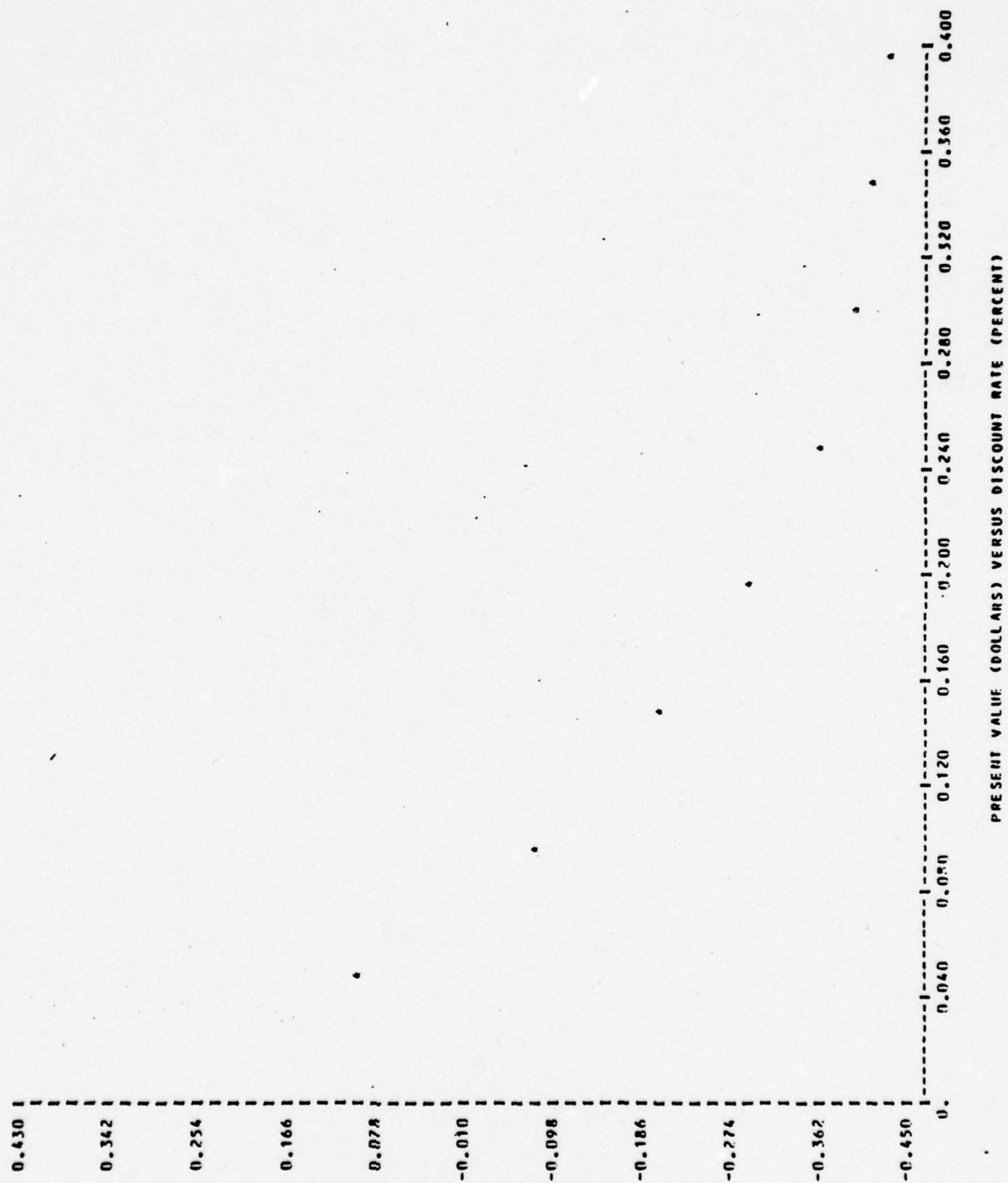
YEAR	PERCENT DEPLETION (18)	LEASEHOLD COST (19)	COST DEPLETION (20)	ALLOWABLE DEPLETION (21)	STATE AMORTIZATION (22)	TAXABLE INCOME (23)	STATE INCOME TAX (24)	FEDERAL TAXABLE INCOME (25)	FEDERAL INCOME TAX (26)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(GREATER) (18 OR 20) (DOLLARS)	(13/2-0) (+ CARRY FWD) (DOLLARS)	(110-22) (DOLLARS)	(-045+25000+) (DOLLARS)	(15-12-24) (DOLLARS)	(-48+25) (DOLLARS)
1	0.	0.	0.	0.	139055.00	-3936485.00	-177141.82	-3082248.84	-1479479.45
2	0.	0.	0.	0.	139055.00	20492520.50	-922188.42	-1865726.25	-8955564.63
3	0.	0.	0.	0.	0.	-643241.34	-28945.86	-945067.90	-453632.59
4	0.	0.	0.	0.	0.	986697.25	665459.81	8937266.25	4289887.81
5	0.	0.	0.	0.	0.	12753861.50	860323.15	11644591.50	589403.94
6	0.	0.	0.	0.	0.	6791789.50	457883.29	6244122.56	2992178.84
7	0.	0.	0.	0.	0.	2714351.19	182656.21	2450665.50	1176319.44
8	0.	0.	0.	0.	-253350.44	964734.31	64557.07	573531.25	275295.00
SUR TOTAL	0.	0.	0.	0.	2544759.56	8014487.00	1102403.41	7165434.06	3439408.28

YEAR	NET CASH FLOW (27)	DISCOUNT FACTOR AT 5 PERCENT (28)	PRESENT WORTH AT 5 PERCENT (29)	CUMULATIVE PRESENT WORTH AT 5 PERCENT (30)	PRESENT WORTH AT 10 PERCENT (31)	CUMULATIVE PRESENT WORTH AT 10 PERCENT (33)	PRESENT WORTH AT 15 PERCENT (34)	CUMULATIVE PRESENT WORTH AT 15 PERCENT (35)
(YEARS)	(DOLLARS)	(PERCENT)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-5678918.72	0.952381	-3503732.13	-3503732.13	-3344471.59	-3344471.59	-3199059.72	-3199059.72
2	-9220512.50	0.907029	-8363276.56	-11867008.75	-7620258.31	-10964729.86	-6922032.06	-10171091.75
3	-140662.89	0.863818	-138786.65	-12005795.38	-120708.41	-1108438.25	-105638.46	-10276730.25
4	4911649.63	0.822702	4040826.34	-7964969.06	3354722.84	-7730715.44	2808251.56	-7468478.69
5	6304134.38	0.783526	4939454.31	-3025514.75	3914371.53	-3816343.91	3134268.88	-4334209.81
6	3336727.38	0.746215	2489917.38	-535597.38	1883495.66	-1932848.25	142559.27	-2891450.56
7	1353375.53	0.710681	963240.09	427642.72	695521.98	-1237326.28	509535.84	-2382114.72
8	878232.68	0.676839	594422.46	1022065.18	409702.04	-827624.24	287095.81	-2095018.91
TOTAL	3726025.47			1022065.18		-827624.24		-2095018.91

YEAR	PRESENT WORTH AT 20 PERCENT (36)	CUMULATIVE PRESENT WORTH AT 20 PERCENT (37)	PRESENT WORTH AT 25 PERCENT (38)	CUMULATIVE PRESENT WORTH AT 25 PERCENT (39)	PRESENT WORTH AT 30 PERCENT (40)	CUMULATIVE PRESENT WORTH AT 30 PERCENT (41)	PRESENT WORTH AT 35 PERCENT (42)	CUMULATIVE PRESENT WORTH AT 35 PERCENT (43)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3065765.59	-3065765.59	-2943134.97	-2943134.97	-2829937.47	-2829937.47	-2725125.00	-2725125.00
2	-6403133.63	-9468899.25	-5901128.00	-8844263.00	-5455924.56	-8285862.06	-5059266.13	-7784391.13
3	-92976.21	-9561875.50	-82259.40	-8926522.38	-73128.31	-8358990.38	-65300.17	-7849691.31
4	2368653.16	-7193217.38	2011811.69	-6914710.69	1719705.06	-6639285.31	1478741.67	-6370949.63
5	2533490.16	-4659727.25	2065738.75	-4848971.94	1697886.70	-4941398.63	1405907.11	-4965042.50
6	1117463.22	-3542264.03	874703.06	-3974268.88	691290.54	-4250108.06	551211.32	-4413831.19
7	378260.43	-3164003.59	284242.85	-3690026.03	216001.21	-4034106.84	165852.98	-4247978.19
8	204248.83	-2959754.75	147342.99	-3542683.03	107662.08	-3926444.75	79604.84	-4168373.34
TOTAL		-2959754.75		-3542683.03		-3926444.75		-4168373.34

YEAR	PRESENT WORTH AT 40 PERCENT (44)	CUMULATIVE PRESENT WORTH AT 40 PERCENT (45)	PRESENT WORTH AT 45 PERCENT (46)	CUMULATIVE PRESENT WORTH AT 45 PERCENT (47)	PRESENT WORTH AT 50 PERCENT (48)	CUMULATIVE PRESENT WORTH AT 50 PERCENT (49)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-2627799.06	-2627799.06	-2537185.31	-2537185.31	-2452612.47	-2452612.47
2	-4704343.06	-7332142.13	-4385499.38	-6922684.69	-4098005.56	-6550618.06
3	-38550.62	-7390692.75	-52700.12	-6975384.81	-47603.82	-6598221.88
4	1278542.67	-6112150.06	1111105.67	-5864279.13	970202.39	-5628019.50
5	1172155.41	-4939994.44	983525.10	-4880754.00	830174.07	-4797845.44
6	443151.78	-4498842.69	359015.09	-4521738.94	292936.29	-4504909.13
7	128571.03	-4368265.69	100573.51	-4421165.44	79326.96	-4425582.19
8	59509.56	-4308756.31	44943.36	-4376222.06	34267.27	-4391314.94
TOTAL		-4308756.31		-4376222.06		-4391314.94

THE RATE OF RETURN EQUALS 7.76 PERCENT.



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

SUMMARY

LOCATION SOUTH CENTRAL BUTLER CO., KS.
 TYPE OF DISPLACEMENT 8 PERCENT MICELLAR AND 70 PERCENT POLYMER
 FIELD EL DORADO
 PRODUCING SAND EL DORADO SHALLOW (ADMIRE)
 SIZE 650 ACRES
 SPACING 5 ACRES
 PATTERN INVERTED 5 SPOT
 NUMBER OF INJECTION WELLS . . . 128
 NUMBER OF PRODUCTION WELLS . . 153
 PRICE OF OIL 14.00 DOLLARS
 RATE OF RETURN 0.08 PERCENT
 CHEMICALS CAPITALIZED
 TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
 APPLY DEPLETION ALLOWANCE . . . NO

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)
1	8.500	0.280
2	8.500	0.280
3	8.500	0.175
4	8.500	0.070
5	8.500	0.070
6	8.500	0.070
7	8.500	0.070
8	8.500	0.070

LIFTING COST FACTOR \$/BBL	WATER INJECTION COST \$/BBL	WATER DISPOSAL COST \$/BBL	MICELLAR INJECTION COST \$/BBL	POLYMER INJECTION COST \$/BBL	GROSS OIL PRODUCTION TREATING COST \$/BBL
0.0320	0.0260	0.0260	0.1840	0.0410	0.4150

TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

RESULTS

YEAR (YEARS) (1)	GROSS OIL PRODUCTION (BARRELS) (2)	NET OIL PRODUCTION (BARRELS) (3)	GROSS INCOME (DOLLARS) (4)	INTANGIBLE COST (DOLLARS) (5)	CHEMICAL COST (DOLLARS) (6)	LIFTING COST (DOLLARS) (7)	GENERAL AND ADMIN COST (DOLLARS) (8)	EXPENSED COST (DOLLARS) (9)
		(7/8X2)	PRICE(3)					(5+6+7+8)
1	0.	0.	0.	2301500.00	0.	0.	236040.00	2537650.00
2	0.	0.	0.	87750.00	0.	867287.98	236040.00	1191077.98
3	93770.88	82049.52	1142693.28	175500.00	0.	493641.44	236040.00	907181.44
4	904078.08	791068.32	11074956.50	117000.00	0.	481338.24	236040.00	834378.24
5	1159918.08	1014928.32	14208996.50	87750.00	0.	922550.98	236040.00	1246340.98
6	624076.80	546067.20	7644940.75	58500.00	0.	558611.24	236040.00	853151.24
7	274885.12	240524.48	3367342.72	29250.00	0.	387701.54	236040.00	652991.55
8	90626.56	79298.24	1110175.34	29250.00	0.	133501.48	236040.00	398791.48
SUB TOTAL	3147355.53	2753956.09	38555105.00	2886390.00	0.	3846632.91	1888320.00	8621343.00

YEAR (YEARS) (1)	GROSS INCOME BEFORE TAX AND DEPL AND DEPR (DOLLARS) (10)	CAPITALIZED CHEMICAL COST (DOLLARS) (11)	TANGIBLE INVESTMENT COST (DOLLARS) (12)	NET TANGIBLE INVESTMENT MINUS SALVAGE (DOLLARS) (13)	DEPRECIATION SL/500/DBB DBBSL (DOLLARS) (14)	NET INCOME BEFORE STATE AND FED TAXES (DOLLARS) (15)	65 PERCENT OF NET INCOME BSFT (DOLLARS) (16)	22 PERCENT OF GROSS INCOME (DOLLARS) (17)
	(6-9)			(11+12-SALVAGE)		(10-14)	(6.5X15)	(.22X4)
1	-2537430.00	0.	2792110.00	2798110.00	721960.66	-3259390.66	-2118603.91	0.
2	-1191077.98	17907387.50	0.	17907387.50	2035162.42	-3226240.41	-2097056.27	0.
3	241511.84	884753.19	0.	884753.19	1971968.70	-1750456.86	-538142.90	451272.36
4	10240578.25	375581.02	0.	375581.02	1945814.30	8294763.94	11047735.00	4350875.75
5	12962655.50	208794.07	0.	208794.07	1950589.23	11006066.25	14410680.50	5582105.75
6	6791789.50	0.	0.	0.	1797425.94	4994363.56	7150716.75	3003369.59
7	2714351.19	0.	0.	0.	1788671.75	925679.44	232141.66	1322884.64
8	711381.87	0.	0.	-506700.88	1780937.86	-1069554.00	-128227.68	436140.32
SUB TOTAL	29933762.25	19374515.75	2792110.00	21665924.75	13998531.00	15935231.25	30048343.25	15146648.50

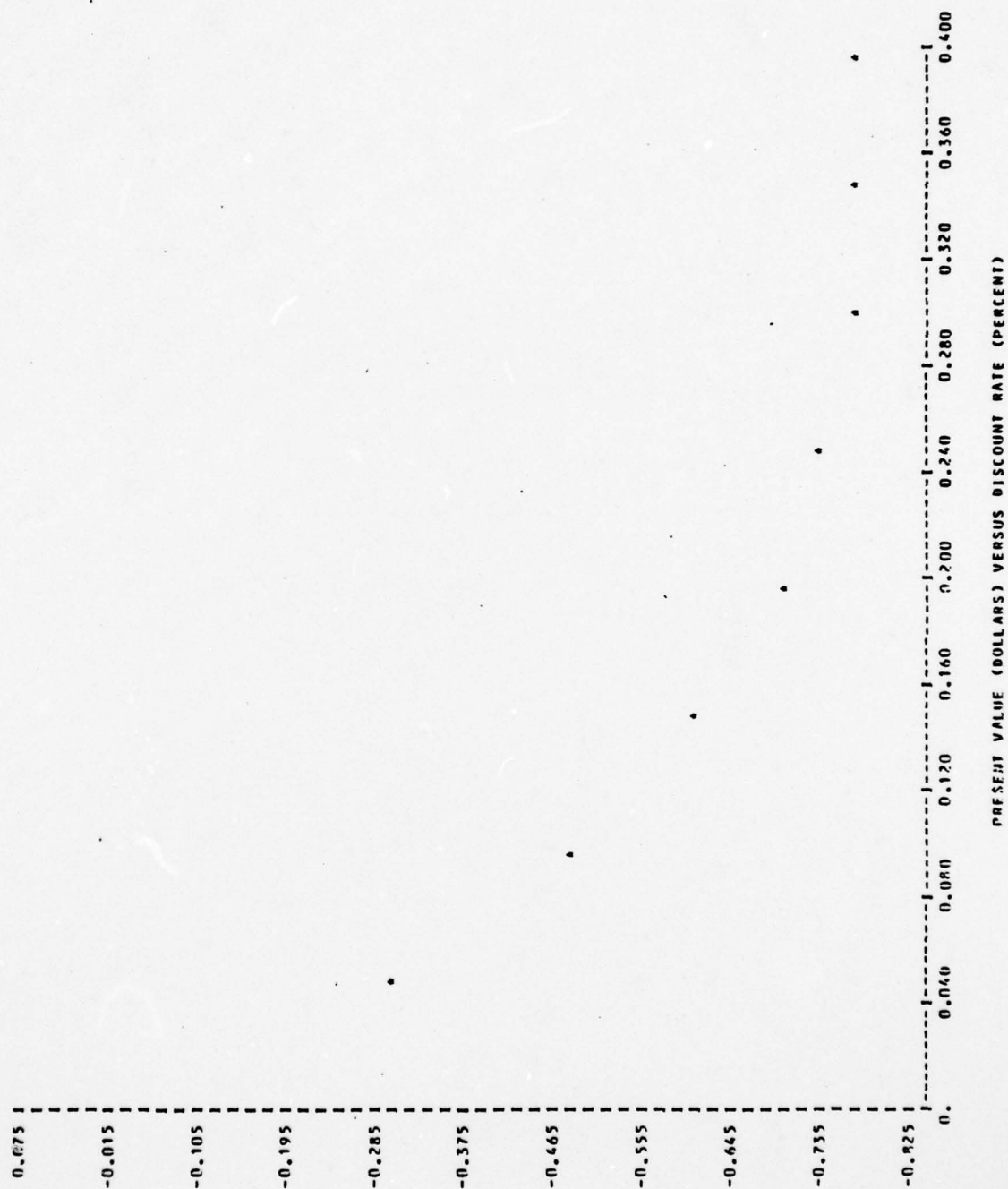
YEAR	PERCENT DEPLETION (18)	LEASEHOLD COST (19)	COST DEPLETION (20)	ALLOWABLE DEPLETION (21)	STATE AMORTIZATION (22)	TAXABLE INCOME (23)	STATE INCOME TAX (24)	FEDERAL TAXABLE INCOME (25)	FEDERAL INCOME TAX (26)
(YEARS)	(16 OR 17)	(DOLLARS)	(DOLLARS)	(GREATER) (18 OR 20)	(13/2, 0) (+ CARRY FWD)	(10-22) (DOLLARS)	(.045*25000.+ ,0675*(22-25000.))	(15-12-24) (DOLLARS)	(.48*25) (DOLLARS)
1	0.	0.	0.	0.	139055.00	-3936485.00	-177141.82	-3082248.84	-1479479.45
2	0.	0.	0.	0.	10352748.75	11543826.75	-519472.20	-2706768.22	-1299248.75
3	0.	0.	0.	0.	9396070.38	-9154558.50	-41955.13	-1318501.73	-632880.84
4	0.	0.	0.	0.	629167.10	9611611.13	648207.75	7646556.19	3670346.97
5	0.	0.	0.	0.	291187.55	12671468.00	854761.59	10151304.63	4872626.25
6	0.	0.	0.	0.	104397.04	6687392.44	450836.49	4543327.06	2180893.00
7	0.	0.	0.	0.	0.	2714351.19	182656.21	743023.23	356651.15
8	0.	0.	0.	0.	-233350.44	964734.31	64557.07	-1134111.06	-544373.31
SUB TOTAL	0.	0.	0.	0.	21919275.25	8014486.81	1092449.92	14842781.38	7124535.00

YEAR	NET CASH FLOW (27)	DISCOUNT FACTOR AT 5 PERCENT (28)	PRESENT WORTH AT 5 PERCENT (29)	CUMULATIVE PRESENT WORTH AT 5 PERCENT (30)	PRESENT WORTH AT 10 PERCENT (31)	CUMULATIVE PRESENT WORTH AT 10 PERCENT (33)	PRESENT WORTH AT 15 PERCENT (34)	CUMULATIVE PRESENT WORTH AT 15 PERCENT (35)
(YEARS)	(DOLLARS)	(PERCENT)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-1678918.72	0.952381	-3503752.13	-3503752.13	-3344471.59	-3344471.59	-3199059.72	-3199059.72
2	-1727974.50	0.907029	-15673237.50	-19176989.75	-14280780.75	-17625252.25	-13065969.25	-16265029.00
3	401594.63	0.863838	346912.54	-18830057.25	301723.99	-17323328.25	264054.98	-16000974.00
4	5548442.50	0.822702	4564717.44	-14265339.88	3789660.97	-13533867.25	3172339.94	-12828634.13
5	7026473.63	0.783526	5505426.00	-8759913.88	4362887.38	-9170799.88	3493399.13	-9335235.00
6	4160060.03	0.746215	3104300.88	-5655613.00	2348243.50	-6822734.38	1798508.69	-7536726.31
7	2175083.81	0.710681	1543763.03	-4109849.97	1116141.42	-5706592.94	817679.49	-6719046.81
8	1697901.00	0.676839	1149206.25	-2960643.72	792083.38	-4914509.56	555046.83	-6164000.00
TOTAL	50852.22			-2960643.72		-4914509.56		-6164000.00

YEAR	PRESENT WORTH AT 20 PERCENT (16)	CUMULATIVE PRESENT WORTH AT 20 PERCENT (17)	PRESENT WORTH AT 25 PERCENT (18)	CUMULATIVE PRESENT WORTH AT 25 PERCENT (19)	PRESENT WORTH AT 30 PERCENT (20)	CUMULATIVE PRESENT WORTH AT 30 PERCENT (21)	PRESENT WORTH AT 35 PERCENT (22)	CUMULATIVE PRESENT WORTH AT 35 PERCENT (23)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3085765.59	-3085765.59	-2943134.97	-2943134.97	-2829937.47	-2829937.47	-2725125.00	-2725125.00
2	-15239822.50	-15065588.13	-11059036.50	-14002171.50	-10224700.88	-13054638.38	-9481341.25	-12206466.25
3	732404.50	-1453185.88	205616.45	-13796555.00	182792.27	-12871846.13	163226.97	-12043241.25
4	2675253.50	-12157430.38	2272642.06	-11523913.00	1942663.95	-10929182.13	1670459.77	-10372781.50
5	2823782.09	-9333648.25	2302436.88	-9221478.13	1892433.67	-9036748.50	1566998.53	-8805783.00
6	1393195.66	-7940452.63	1090536.78	-8130943.38	861865.48	-8174883.00	687221.91	-818561.06
7	607014.80	-7332437.81	456135.75	-7674803.63	346628.73	-7828254.25	266151.17	-7852407.88
8	394877.50	-6938560.31	284860.52	-7389943.13	208144.79	-7620109.44	133901.28	-7698506.63
TOTAL		-6938560.31		-7389943.13		-7620109.44		-7698506.63

YEAR	PRESENT WORTH AT 40 PERCENT (24)	CUMULATIVE PRESENT WORTH AT 40 PERCENT (25)	PRESENT WORTH AT 45 PERCENT (26)	CUMULATIVE PRESENT WORTH AT 45 PERCENT (27)	PRESENT WORTH AT 50 PERCENT (28)	CUMULATIVE PRESENT WORTH AT 50 PERCENT (29)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-2627799.06	-2627799.06	-2537185.31	-2537185.31	-2452612.47	-2452612.47
2	-8416196.13	-11443995.25	-8218665.56	-10755850.88	-7679886.44	-10132498.88
3	146353.72	-11297641.50	131725.76	-10624121.13	118991.00	-10013507.88
4	1444305.08	-9853336.38	1255155.95	-9368961.13	1095988.64	-8917519.25
5	1306463.34	-8546873.00	1096219.20	-8272741.94	925296.94	-7992222.31
6	552498.84	-7994374.19	447601.54	-7825140.38	365217.89	-7627004.44
7	206334.45	-7788039.75	161395.71	-7663744.69	127300.23	-7499704.19
8	115050.58	-7672989.39	86389.71	-7576855.00	66249.45	-7433454.75
TOTAL		-7672989.39		-7576855.00		-7433454.75

THE RATE OF RETURN EQUALS 0.08 PERCENT.



TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

APPLYING DISCOUNTED CASH FLOW

SUMMARY

LOCATION SOUTH CENTRAL BUTLER CO., KS.
 TYPE OF DISPLACEMENT 3 PERCENT MICELLAR AND 70 PERCENT POLYMER
 FIELD EL DORADO
 PRODUCING SAND EL DORADO SHALLOW (ADMIRE)
 SIZE 650 ACRES
 SPACING 5 ACRES
 PATTERN INVERTED 5 SPOT
 NUMBER OF INJECTION WELLS 128
 NUMBER OF PRODUCTION WELLS 153
 PRICE OF OIL 14.00 DOLLARS
 RATE OF RETURN 14.55 PERCENT
 CHEMICALS EXPENSED
 TYPE OF DEPRECIATION DOUBLE DECLINING BALANCE TO SL
 APPLY DEPLETION ALLOWANCE YFS

(YEARS)	MICELLAR SOLUTION COST (DOLLARS PER BARREL)	POLYMER COST (DOLLARS PER BARREL)	WATER INJECTION COST \$/BBL	WATER DISPOSAL COST \$/BBL	MICELLAR INJECTION COST \$/BBL	POLYMER INJECTION COST \$/BBL	GROSS OIL PRODUCTION TREATING COST \$/BBL
1	8.500	0.280					
2	8.500	0.280					
3	8.500	0.175					
4	8.500	0.070					
5	8.500	0.070					
6	8.500	0.070					
7	8.500	0.070					
8	8.500	0.070					
0.0320	0.0260	0.0260	0.0260	0.1840	0.0410	0.4150	

TERTIARY OIL RECOVERY PROJECT
ECONOMIC PROGRAM

RESULTS

YEAR (YEARS) (1)	GROSS OIL PRODUCTION (BARRELS) (2)	NET OIL PRODUCTION (BARRELS) (3) (7/8x2)	GROSS INCOME (DOLLARS) (4) PRICE(x3)	INTANGIBLE COST (DOLLARS) (5)	CHEMICAL COST (DOLLARS) (6)	LIFTING COST (DOLLARS) (7)	GENERAL AND ADMIN COST (DOLLARS) (8)	EXPENSED COST (DOLLARS) (9) (5x6+7+8)
1	0.	0.	0.	2301390.00	0.	0.	236040.00	2537430.00
2	0.	0.	0.	87750.00	17907387.50	867287.98	236040.00	19098465.50
3	93770.48	82067.52	1148693.28	173500.00	884753.19	495641.44	236040.00	1791934.63
4	904078.08	791068.32	11074956.50	117000.00	373381.02	481338.24	236040.00	1207959.27
5	1159918.08	1014928.32	14208996.50	87750.00	208794.07	922530.98	236040.00	1455135.06
6	624076.80	546067.20	7644940.75	58500.00	0.	558611.24	236040.00	853151.24
7	274885.12	240524.48	3367342.72	29250.00	0.	387701.54	236040.00	652991.55
8	90626.56	79298.24	1110175.34	29250.00	0.	133501.48	236040.00	398791.48
SUB TOTAL	3147355.53	2753936.09	38555105.00	2886390.00	19374515.75	3846632.91	1888320.00	27995838.75

YEAR (YEARS) (1)	GROSS INCOME BEFORE TAX AND DEPL AND DEPR (DOLLARS) (10) (4-9)	CAPITALIZED CHEMICAL COST (DOLLARS) (11)	TANGIBLE INVESTMENT COST (DOLLARS) (12)	NET TANGIBLE INVESTMENT MINUS SALVAGE (DOLLARS) (13) (11+12-SALVAGE)	DEPRECIATION SL/STYOD/DOB DOBSL (DOLLARS) (14)	NET INCOME BEFORE STATE AND FED TAXES (DOLLARS) (15) (10-14)	65 PERCENT OF NET INCOME BSFT (DOLLARS) (16) (.65x15)	22 PERCENT OF GROSS INCOME (DOLLARS) (17) (.22x4)
1	-2537430.00	0.	2798110.00	2798110.00	721960.66	-3259390.66	-2118603.91	0.
2	-19098465.50	0.	0.	0.	481349.18	19579814.75	-12726879.50	0.
3	-643241.34	0.	0.	0.	330772.41	-974013.76	-633108.94	252712.52
4	9866997.25	0.	0.	0.	264271.27	9602726.00	6241771.88	2436490.44
5	12753861.50	0.	0.	0.	248946.93	12504914.63	8128194.50	3125979.25
6	6791780.50	0.	0.	0.	89783.65	6702005.88	4356303.81	1681886.97
7	2714351.19	0.	0.	0.	81029.46	2633321.72	1711659.11	740815.40
8	711383.87	0.	0.	-506700.88	73295.56	638088.31	414757.40	244238.58
SUB TOTAL	10559246.63	0.	2798110.00	2291409.13	2291409.16	8267837.51	5374094.31	8482123.25

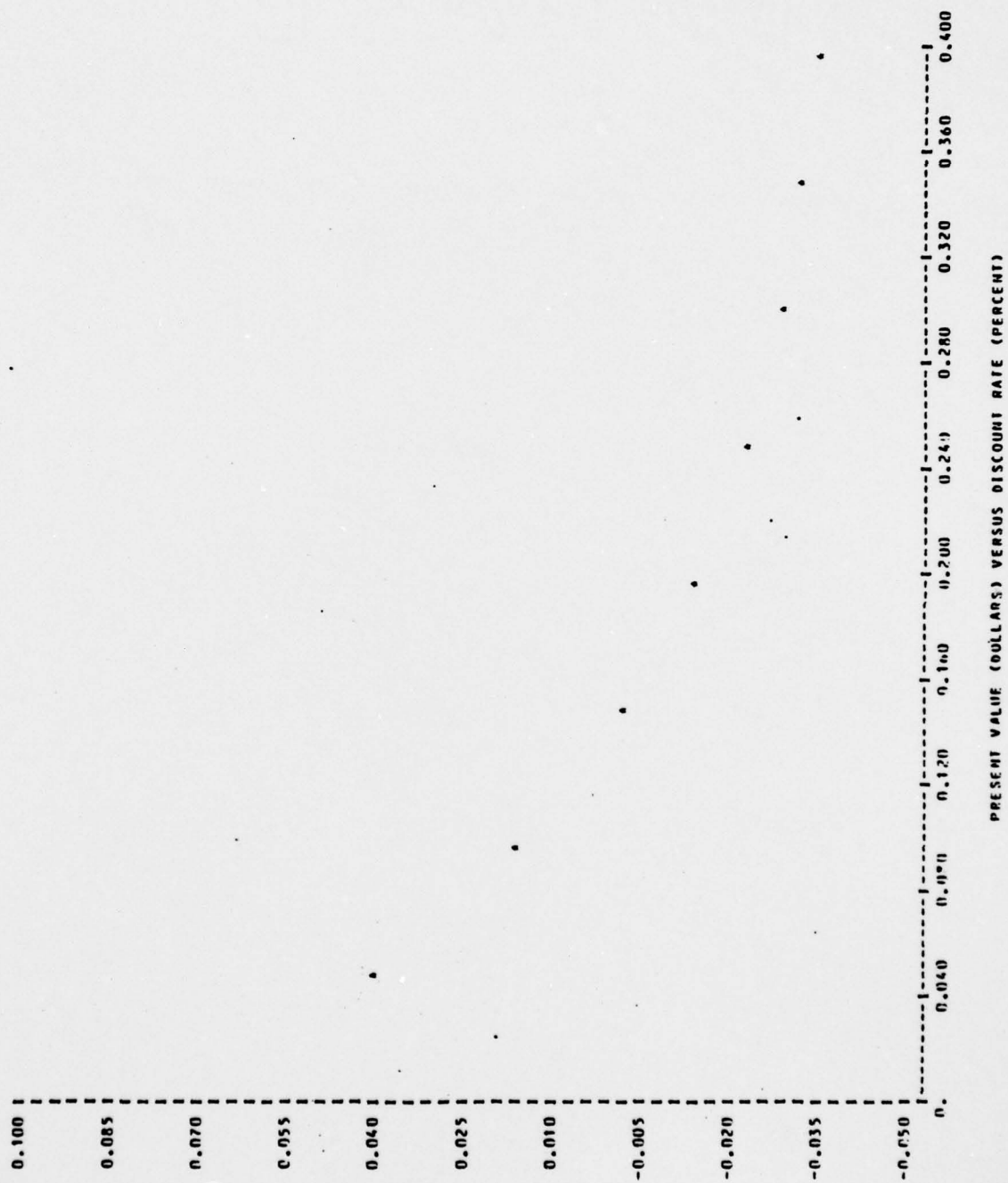
YEAR	PERCENT DEPLETION (18)	LEASEHOLD COST (19)	COST DEPLETION (20)	ALLOWABLE DEPLETION (21)	STATE AMORTIZATION (22)	TAXABLE INCOME (23)	STATE INCOME TAX (24)	FEDERAL TAXABLE INCOME (25)	FEDERAL INCOME TAX (26)
(YEARS)	(16 OR 17)	(DOLLARS)	(DOLLARS)	(18 OR 20)	(+ CARRY FWD)	(10-22)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	0.	0.	0.	0.	1399055.00	-1936485.00	-177141.82	-3082248.84	-1479479.45
2	0.	0.	0.	0.	1399055.00	20497520.50	-922388.42	-18657426.25	-8953564.63
3	0.	0.	0.	0.	0.	-643241.34	-28945.86	-945067.90	-453632.59
4	2436490.44	0.	0.	2436490.44	0.	9866997.25	665459.81	6500775.75	3120372.38
5	3125979.25	0.	0.	3125979.25	0.	12753861.50	860323.15	8518612.25	4088913.88
6	1681886.97	0.	0.	1681886.97	0.	6791789.50	457883.29	4562235.63	2189873.09
7	740815.40	0.	0.	740815.40	0.	2714351.19	182656.21	1709850.11	820728.05
8	244238.58	0.	0.	244238.58	-233350.44	964734.31	64557.07	329292.67	158060.48
SUB TOTAL	8229410.63	0.	0.	8229410.63	2544759.56	8014487.00	1102403.41	-1063976.59	-510708.87

YEAR	NET CASH FLOW (27)	DISCOUNT FACTOR AT 5 PERCENT (28)	PRESENT WORTH AT 5 PERCENT (29)	CUMULATIVE PRESENT WORTH AT 5 PERCENT (30)	PRESENT WORTH AT 10 PERCENT (31)	CUMULATIVE PRESENT WORTH AT 10 PERCENT (33)	PRESENT WORTH AT 15 PERCENT (34)	CUMULATIVE PRESENT WORTH AT 15 PERCENT (35)
(YEARS)	(DOLLARS)	(PERCENT)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3678918.72	0.952381	-3503732.13	-3503732.13	-3344471.59	-3344471.59	-3190059.72	-3190059.72
2	-9220512.50	0.907029	-8363276.56	-11867008.75	-7620258.31	-10964729.88	-6927032.06	-10171091.75
3	-160662.89	0.863838	-138786.65	-12005795.38	-120708.41	-11085438.25	-105638.46	-10276730.23
4	6081165.06	0.822702	5002989.56	-7002805.81	4153517.66	-6931920.63	3476925.78	-6799806.50
5	7804604.44	0.783526	6115111.88	-887693.94	4846045.44	-2085875.19	3880267.66	-2919536.84
6	4144033.13	0.746215	3092341.34	2204647.41	2339198.72	253323.53	1791579.81	-1127957.03
7	1710966.21	0.710681	1215952.25	3420599.66	877996.59	1131320.13	643215.80	-484741.23
8	995467.20	0.676439	673771.39	4094371.06	464392.81	1595712.94	325419.98	-159321.25
TOTAL	7676142.63			4094371.06		1595712.94		-159321.25

YEAR	PRESENT WORTH AT 20 PERCENT (36)	CUMULATIVE PRESENT WORTH AT 20 PERCENT (37)	PRESENT WORTH AT 25 PERCENT (38)	CUMULATIVE PRESENT WORTH AT 25 PERCENT (39)	PRESENT WORTH AT 30 PERCENT (40)	CUMULATIVE PRESENT WORTH AT 30 PERCENT (41)	PRESENT WORTH AT 35 PERCENT (42)	CUMULATIVE PRESENT WORTH AT 35 PERCENT (43)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-3065765.59	-3065765.59	-2943134.97	-2943134.97	-2829937.47	-2829937.47	-2725125.00	-2725125.00
2	-6403133.63	-9468899.25	-5901128.00	-8844263.00	-5455924.56	-828582.06	-5059266.13	-7784391.13
3	-92976.21	-9561875.50	-82259.40	-8926522.38	-23128.31	-8358990.38	-65300.17	-7849691.31
4	2932660.59	-6629214.94	2490845.22	-6435677.19	2129184.94	-6229805.44	1830845.61	-6018845.69
5	3176495.41	-3402719.53	2557412.78	-3878264.41	2102006.91	-4127798.53	1740332.20	-4278313.50
6	1387828.28	-2104891.25	1086333.42	-2791931.00	858545.09	-3269253.44	684574.34	-3593739.16
7	472499.45	-1627391.80	358815.77	-2433115.22	272670.50	-2996582.94	209365.56	-3384373.59
8	231513.85	-1395877.95	167011.68	-2266103.53	122033.60	-2874549.13	90231.22	-3294142.38
TOTAL		-1395877.95		-2266103.53		-2874549.13		-3294142.38

YEAR	PRESENT WORTH AT 40 PERCENT (44)	CUMULATIVE PRESENT WORTH AT 40 PERCENT (45)	PRESENT WORTH AT 45 PERCENT (46)	CUMULATIVE PRESENT WORTH AT 45 PERCENT (47)	PRESENT WORTH AT 50 PERCENT (48)	CUMULATIVE PRESENT WORTH AT 50 PERCENT (49)
(YEARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)	(DOLLARS)
1	-2627799.06	-2627799.06	-2537185.31	-2537185.31	-2452612.47	-2452612.47
2	-4704343.06	-7332142.13	-4385495.38	-6922684.69	-4098005.56	-6550618.06
3	-59550.42	-7390692.75	-52700.12	-6975384.81	-47603.82	-6598221.88
4	1582977.13	-5807715.63	1375671.61	-5599713.19	1201217.78	-5397004.13
5	1451144.64	-4356571.00	1217617.50	-4382095.69	1027766.84	-4369237.31
6	550370.30	-3806200.72	445977.13	-3936218.56	363810.86	-4005426.44
7	162310.03	-3643890.69	126955.61	-3809258.90	100138.90	-3905287.53
8	67453.21	-3576437.47	50942.81	-3758316.13	38061.58	-3866445.94
TOTAL		-3576437.47		-3758316.13		-3866445.94

THE RATE OF RETURN EQUALS 14.55 PERCENT.



APPENDIX G

TERTIARY OIL RECOVERY PROJECT
MICELLAR PROGRAM

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INPUT DATA

TEST CASE NO. 1 ELDORADO FIELD, 650 FOOT SAND, BUTLER COUNTY, KANSAS

OIL VISCOSITY	4.77000 CP	
WATER VISCOSITY	1.02000 CP	
PRESSURE DROP	400.00000 PSI	
ABSOLUTE PERMEABILITY	200.00000 MD	
POROSITY	0.26200	
INITIAL OIL SATURATION	0.28000	
BYPASSED WATER SATURATION	0.20000	
WATER SATURATION IN MICELLAR		
BANK AFTER POLYMER INJECTION	0.30000	
DESIGN MICELLAR SLUG SIZE	8.00000 PERCENT PORE VOLUME	
DESIGN POLYMER SLUG SIZE	70.00000 PERCENT PORE VOLUME	
CONVERGENCE CRITERIA	0.00001	
NUMBER OF CHANNELS	4	
NUMBER OF CELLS	40	

SHAPE FACTORS . . .

CHANNEL 1	CHANNEL 2	CHANNEL 3	CHANNEL 4	CHANNEL 5	CHANNEL 6
17.372	17.880	19.620	36.582	0.	0.
1.506	1.558	1.696	2.920	0.	0.
0.886	0.900	0.950	1.848	0.	0.
0.631	0.639	0.670	1.197	0.	0.
0.495	0.495	0.536	0.928	0.	0.
0.397	0.397	0.440	0.768	0.	0.
0.325	0.331	0.363	0.643	0.	0.
0.286	0.282	0.306	0.535	0.	0.
0.256	0.245	0.262	0.451	0.	0.
0.231	0.220	0.229	0.378	0.	0.
0.211	0.200	0.203	0.310	0.	0.
0.196	0.185	0.182	0.253	0.	0.
0.183	0.172	0.166	0.205	0.	0.
0.173	0.162	0.152	0.167	0.	0.
0.166	0.155	0.229	0.139	0.	0.
0.161	0.150	0.128	0.121	0.	0.
0.158	0.147	0.118	0.108	0.	0.
0.155	0.144	0.110	0.096	0.	0.
0.152	0.139	0.105	0.088	0.	0.
0.150	0.124	0.101	0.082	0.	0.
0.150	0.124	0.101	0.082	0.	0.
0.152	0.139	0.105	0.088	0.	0.
0.155	0.144	0.110	0.096	0.	0.
0.158	0.147	0.118	0.108	0.	0.
0.161	0.150	0.128	0.121	0.	0.
0.166	0.155	0.139	0.139	0.	0.

0.173	0.162	0.152	0.167	0.	0.
0.183	0.172	0.166	0.205	0.	0.
0.196	0.185	0.182	0.253	0.	0.
0.211	0.200	0.203	0.310	0.	0.
0.231	0.220	0.229	0.378	0.	0.
0.256	0.245	0.262	0.451	0.	0.
0.286	0.282	0.306	0.535	0.	0.
0.325	0.331	0.363	0.643	0.	0.
0.397	0.397	0.440	0.768	0.	0.
0.495	0.495	0.536	0.928	0.	0.
0.631	0.639	0.670	1.197	0.	0.
0.886	0.900	0.950	1.848	0.	0.
1.506	1.558	1.696	2.920	0.	0.
17.372	17.880	19.620	36.582	0.	0.

RELATIVE PERMEABILITY DATA . . .

WATER SATURATION	REL. PERM. TO OIL	REL. PERM. TO WATER
0.2500	1.0000	0.0000
0.2729	0.8500	0.0004
0.2959	0.7800	0.0080
0.3188	0.6700	0.0200
0.3418	0.5700	0.0340
0.3647	0.4800	0.0450
0.3877	0.4000	0.0580
0.4106	0.3100	0.0700
0.4336	0.2700	0.0770
0.4565	0.2100	0.0890
0.4795	0.1750	0.0990
0.5024	0.1250	0.1100
0.5254	0.1000	0.1200
0.5483	0.0750	0.1300
0.5713	0.0480	0.1480
0.5942	0.0330	0.1600
0.6172	0.0210	0.1850
0.6401	0.0135	0.2000
0.6630	0.0065	0.2250
0.6860	0.0033	0.2500
0.7090	0.0008	0.2800
0.7200	0.0000	0.3000

AT INITIAL SATURATIONS KRO = 0.00001000 KRW = 0.30000000

IN STABILIZED BANK, SOM = 0.67207999 SWM = 0.32792001
 KRO = 0.62758017 KRW = 0.02554254

POLYMER SECTION . . .

AT SOF = 0.61699503 PO = 0.41573154 PW = 0.05518297
 DESIGN POLYMER SLUG VOLUME = 4993.06500244 FT**3
 NUMBER OF BATCHES = 3
 VOLUME PER BATCH = 1664.35499573 FT**3

SUMMARY AT END OF BATCH 1

TOTAL POLYMER INJECTED = 1664.35499573
 TOTAL POLYMER TIME = 423.28149032

CHANNEL	CUM POLY	CELLS POLY	CELLS MICELLAR	CELLS STAB.BANK	CELLS REMAINING
1	486.81034	12.20351	6.01419	15.13659	6.64572
2	480.18583	10.86673	5.33361	13.46042	10.33924
3	447.71500	8.63372	4.21306	10.67404	16.47918
4	249.64385	5.88956	2.85750	7.26769	23.98525

SUMMARY AT END OF BATCH 2

TOTAL POLYMER INJECTED = 3328.70999146
 TOTAL POLYMER TIME = 828.42684936

CHANNEL	CUM POLY	CELLS POLY	CELLS MICELLAR	CELLS STAB.BANK	CELLS REMAINING
1	941.18211	23.59383	6.01419	10.39198	0.
2	946.74466	21.42508	5.33361	13.24131	0.
3	920.49495	17.75080	4.21306	18.03615	0.
4	520.28844	12.27456	2.85750	12.57281	12.29513

SUMMARY AT END OF BATCH 3

TOTAL POLYMER INJECTED = 4993.06500244
 TOTAL POLYMER TIME = 1194.05729675

CHANNEL	CUM POLY	CELLS POLY	CELLS MICELLAR	CELLS STAB.BANK	CELLS REMAINING
1	1405.05685	35.22238	4.77762	0.	0.
2	1410.73297	31.92525	5.33361	2.74114	0.

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3	1354.94763	26.12877	4.21306	9.65817	0.
4	822.32764	19.40021	2.85750	17.74229	0.

SUMMARY OF CONDITIONS AT END OF MICELLAR INJECTION

TOTAL ELAPSED TIME	=	82.34288693 DAYS
TOTAL VOLUME INJECTED	=	570.63600159 FT**3
DESIGN MICELLAR SLUG VOLUME	=	570.63600159 FT**3

CHANNEL	CUM MICELLAR	CELLS MICELLAR	CELLS STAB. BANK	CELLS REMAINING
1	167.93851	5.26242	3.75810	30.97948
2	164.97948	4.66691	3.33283	32.00026
3	152.93229	3.68643	2.63262	33.68095
4	84.78572	2.50031	1.78557	35.71411

AD-A052 683

KANSAS UNIV LAWRENCE DEPT OF CHEMICAL AND PETROLEUM--ETC F/G 8/9
DEVELOPMENT AND APPLICATION OF A COMPUTERIZED ECONOMIC MODEL FO--ETC(U)
1976 G N PLOCEK

UNCLASSIFIED

NL

3 OF 3
AD
A052 683



END
DATE
FILMED
5-78
DDC

473-1463	15448-415283	41760-024414	0-	57208-439453	0-	0-	0-
498-1287	15448-415283	44298-142378	0-	59746-58103	0-	0-	0-
505-6244	15448-415283	43057-877441	0-	60506-292969	0-	0-	0-
539-7020	15448-415283	48802-106445	0-	64250-521973	0-	0-	0-
543-1865	15448-415283	49216-245117	0-	64664-600445	0-	0-	0-
552-7816	15448-415283	50296-873047	0-	65745-289062	0-	0-	0-
571-2656	15448-415283	52471-158691	0-	67919-574219	0-	0-	0-
574-2013	15448-415283	52815-853027	0-	68264-269531	0-	0-	0-
578-2609	15448-415283	53298-609375	0-	68747-024367	0-	0-	0-
596-1380	15448-415283	53426-333008	0-	70874-750977	0-	0-	0-
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613-0310	15448-415283	57414-736816	0-	72863-154297	0-	0-	0-
637-1229	15448-415283	60222-608203	0-	75670-824219	0-	0-	0-
637-3546	15448-415283	60249-442383	0-	75697-859375	0-	0-	0-
639-2476	15448-415283	60465-961914	0-	75914-378906	0-	0-	0-
647-9351	15448-415283	61459-891602	0-	76840-502930	0-	0-	0-
674-1461	15448-415283	64470-356445	0-	79375-233398	0-	0-	0-
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683-2753	15448-415283	65688-323730	0-	80232-227539	0-	0-	0-
699-6617	15448-415283	67312-126953	0-	81760-618164	0-	0-	0-
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1163-5929	15448-415283	121220-107422	0.	116702-305664	19964-223389	0.	0.
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1190-3262	15448-415283	124605-773633	0.	118382-428711	21671-966309	0.	0.
1193-1046	15448-415283	124930-159180	0.	118543-291016	21835-288574	0.	0.
1213-3404	15448-415283	127466-912109	0.	119802-880859	23112-451660	0.	0.
1217-2348	15448-415283	128007-565477	0.	120064-181641	23389-801514	0.	0.
1224-1184	15448-415283	128830-177734	0.	120466-766602	23811-830811	0.	0.
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1268-6735	15448-415283	134246-292969	0.	123018-163086	25923-684324	752-868875	0.
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1308-6800	15448-415283	135173-632812	0.	125115-154297	27482-349385	1490-756073	0.
1310-9428	15448-415283	135173-632812	3846-227325	125238-813477	27776-783203	1743-747375	0.
1318-6695	15448-415283	135173-632812	4137-292403	125676-659414	28110-863037	1931-253219	0.
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1373-2397	15448-415283	135173-632812	10196-561279	128033-450391	30989-385010	3202-673157	0.
1380-0280	15448-415283	135173-632812	11603-657349	128324-322264	31351-102295	3361-647125	0.
1404-0480	15448-415283	135173-632812	12417-019531	129139-466797	32353-980225	3803-483429	0.
1405-5196	15448-415283	135173-632812	14676-878662	129361-476563	32630-298828	3924-170593	0.
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1470-0793	15448-415283	135173-632812	22024-034229	131782-880859	35838-212402	5799-993789	0.
1483-6558	15448-415283	135173-632812	23168-611328	132155-455078	36404-694824	6276-801270	0.
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1518-1984	15448-415283	135173-632812	26924-583394	133461-443359	37845-987793	7404-054199	0.
1526-0755	15448-415283	135173-632812	28118-328564	134090-537109	38174-600645	7855-970823	0.
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1534-6389	15448-415283	135173-632812	30248-384766	134625-259764	38531-970703	7930-491438	117-483747
1552-7410	15448-415283	135173-632812	30582-594053	134761-982422	40184-545898	8940-289307	316-269276
1566-9188	15448-415283	135173-632812	32447-186035	135427-787109	40728-573730	9245-654277	423-064632
1574-2452	15448-415283	135173-632812	34279-087891	135937-306641	42728-573730	9524-470898	413-838158
1587-2836	15448-415283	135173-632812	35126-454590	136200-603514	41225-229004	9936-747070	789-011658
1599-1986	15448-415283	135173-632812	36014-736816	137097-375000	41930-918945	1049-530070	1049-530070
1616-7945	15448-415283	135173-632812	38014-736816	137229-734375	42066-143555	1087-991013	1087-991013
1619-3603	15448-415283	135173-632812	40349-876758	137729-224609	42169-847187	1129-327591	1129-327591
1621-6262	15448-415283	135173-632812	40642-291504	137910-562500	42572-608887	10054-584104	1302-214080
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1688-3499	15448-415283	135173-632812	48358-181641	140301-281250	45268-347674	11792-546509	2366-761688
1690-9114	15448-415283	135173-632812	48862-985840	140393-537891	45510-645039	11929-662354	2563-462158
1696-0382	15448-415283	135173-632812	49737-035645	140577-582031			
1701-8931	15448-415283	135173-632812	50169-734375	140787-996094			

1725-4540	15448-415283	135173-632812	532973-333496	141636-226563	46693-746582	12481-433596	2985-478229
1728-3180	15448-415283	135173-632812	53314-129884	141737-652344	46613-246582	12548-505005	3036-777618
1746-4424	15448-415283	135173-632812	53232-826172	142317-128906	47286-037599	12926-120117	3325-592621
1752-4157	15448-415283	135173-632812	56181-560680	142603-671875	47181-724121	13112-845947	3468-408051
1759-9946	15448-415283	135173-632812	57083-480664	142966-021484	47935-039551	13290-383623	3514-289276
1760-5979	15448-415283	135173-632812	57155-222656	142998-398438	47960-135977	13304-463501	3514-289276
1786-9917	15448-415283	135173-632812	60295-917480	144419-693359	49061-410156	13922-577759	3514-289276
1792-8777	15448-415283	135173-632812	60996-316895	144736-654297	49307-004883	14060-421997	3514-289276
1794-5392	15448-415283	135173-632812	61194-027344	144826-126953	49376-332520	14099-333252	3514-289276
1816-4814	15448-415283	135173-632812	63805-012695	146007-707031	50291-874512	14613-196167	3514-289276
1825-1575	15448-415283	135173-632812	64837-410645	146474-910156	50653-884766	14816-380493	3514-289276
1829-0818	15448-415283	135173-632812	65304-375488	146886-232422	50817-625488	14908-282959	3514-289276
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1857-4374	15448-415283	135173-632812	68678-504883	148213-167969	52000-763184	15572-338989	3514-289276
1863-6264	15448-415283	135173-632812	69414-723633	148566-337891	52258-918457	15717-232788	3514-289276
1872-0902	15448-415283	135173-632812	70422-101563	149002-218750	52612-134785	15915-492920	3514-289276
1880-5472	15448-415283	135173-632812	71628-429688	149457-635000	52965-023438	16113-546387	3514-289276
1889-7172	15448-415283	135173-632812	72519-599609	149931-423828	53347-642090	16328-297485	3514-289276
1898-1670	15448-415283	135173-632812	73525-072266	150406-443359	53700-210938	16526-182617	3514-289276
1914-6395	15448-415283	135173-632812	75485-194336	151293-480469	54387-527344	16911-950684	3514-289276
1921-9971	15448-415283	135173-632812	76366-693359	151889-879688	54694-521484	17086-256104	3514-289276
1932-7096	15448-415283	135173-632812	77633-419922	152266-346875	55141-503906	17335-132568	3514-289276
1944-6130	15448-415283	135173-632812	79051-845703	152907-539063	55638-173340	17613-894684	3514-289276
1954-2769	15448-415283	135173-632812	80201-789063	153427-935547	56041-400391	17840-214600	3514-289276
1957-1888	15448-415283	135173-632812	80548-288086	153584-742188	56162-900391	17908-408447	3514-289276
1967-2522	15448-415283	135173-632812	81745-769331	154126-652344	56582-797363	18144-082520	3514-289276
1986-5567	15448-415283	135173-632812	84042-883789	155166-193359	57388-280273	18596-173340	3514-289276
1999-7794	15448-415283	135173-632812	85611-380859	155876-003906	57938-273438	18904-866211	3514-289276
2001-7961	15448-415283	135173-632812	85856-119141	155986-537031	58024-090332	18953-032471	3514-289276
2008-6788	15448-415283	135173-632812	86675-265625	156357-457031	58311-323242	19114-273314	3514-289276
2018-8364	15448-415283	135173-632812	87883-979492	156904-451172	58735-158691	19352-132080	3514-289276
2036-3376	15448-415283	135173-632812	89964-666797	157846-863281	59465-382324	19761-982422	3514-289276
2042-2874	15448-415283	135173-632812	90674-473633	158167-267578	59713-445508	19901-323975	3514-289276
2051-1165	15448-415283	135173-632812	91725-073242	158642-707031	60082-038574	20180-090576	3514-289276
2070-8800	15448-415283	135173-632812	94076-815430	159706-968750	60906-626270	20570-932129	3514-289276
2072-7446	15448-415283	135173-632812	94298-681641	159807-373047	60986-473633	20614-597612	3514-289276
2083-1943	15448-415283	135173-632812	95564-168945	160380-962891	61428-916992	20864-049072	3514-289276
2084-8167	15448-415283	135173-632812	95737-566406	160458-529297	61489-018555	20897-781738	3514-289276
2105-4224	15448-415283	135173-632812	98187-162109	161567-074219	62347-969238	21379-882080	3514-289276
2115-4761	15448-415283	135173-632812	99407-261719	162119-220703	62775-796875	21620-002324	3514-289276
2127-3860	15448-415283	135173-632812	100800-659180	162749-791016	63264-391602	21894-232558	3514-289276
2136-8104	15448-415283	135173-632812	101922-098633	163257-289062	63657-624512	22114-947510	3514-289276
2139-9652	15448-415283	135173-632812	102297-510742	163427-179688	63789-263184	22188-831787	3514-289276
2147-9560	15448-415283	135173-632812	103548-356445	163857-478516	64122-677246	22375-965820	3514-289276
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2200-8761	15448-415283	135173-632812	109545-512695	166707-207031	66330-775391	23615-292607	3514-289276
2209-0504	15448-415283	135173-632812	103188-205078	167147-390623	66671-849609	23806-731201	3514-289276
2212-4466	15448-415283	135173-632812	110926-842773	167332-316406	66815-138672	23887-154297	3514-289276
2215-5157	15448-415283	135173-632812	110930-543945	167333-992187	66816-436272	23887-882813	3514-289276
2243-5930	15448-415283	135173-632812	114628-551758	169007-496094	68113-142578	24615-681152	3514-289276
2244-7955	15448-415283	135173-632812	114771-535742	169072-246094	68163-315430	24643-841309	3514-289276
2255-0338	15448-415283	135173-632812	115989-933594	169623-576172	68590-510742	24883-612061	3514-289276
2264-9419	15448-415283	135173-632812	117168-928711	170157-121094	69003-925781	25115-647949	3514-289276
2277-0753	15448-415283	135173-632812	118612-731445	170810-501953	69510-194336	25399-799805	3514-289276
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2307-5832	15448-415283	135173-632812	121053-025391	171914-839844	70365-883789	25880-069580	3514-289276
2309-3552	15448-415283	135173-632812	122653-824219	172548-759766	70857-073242	26155-758301	3514-289276

2312-6703	15448-415203	135173-632812	122849-245117	172727-705078	70995-728516	24233-580811	3514-289276
2329-0077	15448-415203	135173-632812	124792-340820	173407-037109	71677-074172	24615-998047	3514-289276
2340-1344	15448-415203	135173-632812	126116-112303	174206-101563	72141-236836	26876-527588	3514-289276
2341-6350	15448-415203	135173-632812	126294-915039	174287-015625	72203-953125	26911-717041	3514-289276
2347-2209	15448-415203	135173-632812	126959-591797	174587-810547	72437-021484	27042-530762	3514-289276
2373-9149	15448-415203	135173-632812	130116-008789	174025-273438	73550-833008	27467-675537	3514-289276
2381-7435	15448-415203	135173-632812	131069-937500	176447-916016	73878-416453	27851-480225	3514-289276
2382-6817	15448-415203	135173-632812	131179-205078	176497-363281	73916-628906	27872-985107	3514-289276
2393-0735	15448-415203	135173-632812	132413-755859	177056-955078	74350-225586	28116-348389	3514-289276
2404-1947	15448-415203	135173-632812	133977-101563	177763-529297	74897-711914	28423-634277	3514-289276
2416-3061	15448-415203	135173-632812	135180-287109	178308-019531	75319-608398	28660-430664	3514-289276
2425-2310	15448-415203	135173-632812	136242-298828	178788-625000	75692-001953	28869-443115	3514-289276
2438-4746	15448-415203	135173-632812	137818-197266	179501-785156	76244-590820	29179-592773	3514-289276
2450-8407	15448-415203	135173-632812	139290-634766	180168-123047	76760-901367	29449-380615	3514-289276
2457-1393	15448-415203	135173-632812	140039-171875	180506-869141	77023-373977	29616-698730	3514-289276
2467-7803	15448-415203	135173-632812	141303-388672	181079-886719	77467-373000	29865-900879	3514-289276
2470-7544	15448-415203	135173-632812	141659-291016	181240-041016	77591-470703	29935-551514	3514-289276
2485-3913	15448-415203	135173-632812	143400-980469	182028-230469	78202-196336	30278-330322	3514-289276
2503-0343	15448-415203	135173-632812	145500-384766	182978-298828	78938-350584	30691-509766	3514-289276
2510-3296	15448-415203	135173-632812	146368-482422	183371-148438	79242-748047	30862-358398	3514-289276
2519-9339	15448-415203	135173-632812	147511-328125	183888-335938	79643-482305	31087-280273	3514-289276
2521-2030	15448-415203	135173-632812	147662-585937	183956-781109	79696-527344	31117-069316	3514-289276
2535-3141	15448-415203	135173-632812	149341-476563	184716-554688	80285-229492	31447-468506	3514-289276
2552-8789	15448-415203	135173-632812	151431-570312	185662-412109	81018-121094	31858-816162	3514-289276
2554-4705	15448-415203	135173-632812	151621-673828	185748-441406	81084-781250	31896-230225	3514-289276
2567-5940	15448-415203	135173-632812	153182-568359	186454-812500	81632-108398	32205-427246	3514-289276

APPENDIX H

SYNOPSIS OF TEST CASE
650' EL DORADO SHALLOW, 650-ACRE
EL DORADO FIELD
PRICE = f(RATE OF RETURN)

TRIAL RUN	METHOD OF DEPRECIATION SLD/SYOD/DDSL/DDSL (1)/(2)/(3)/(4)	22X STATUTORY DEPLETION Yes/No (1)/(2)	CHEMICALS Expensed/Capitalized (1) / (2)	RATE OF RETURN %	PRICE OF OIL, \$		
					207 BBLs/ac-ft	258 BBLs/ac-ft	310 BBLs/ac-ft
1	DDSL	No	Expensed	10.00	18.64	14.97	12.54
				12.00	19.64	15.79	13.19
				14.00	20.75	16.65	13.96
				16.00	21.88	17.57	14.68
				18.00	23.01	18.48	15.45
				20.00	24.29	19.51	16.29
				22.00	25.47	20.43	17.07
				24.00	26.74	21.41	17.89
				26.00	28.10	22.55	18.80
				30.00	30.93	24.80	20.67
2	DDSL	No	Capitalized	10.00	24.79	20.00	16.66
				12.00	26.32	21.12	17.68
				14.00	28.05	22.49	18.83
				16.00	29.89	23.93	20.00
				18.00	31.52	25.27	21.12
				20.00	33.56	26.92	22.47
				22.00	35.32	28.31	23.64
				24.00	37.30	29.89	24.92
				26.00	39.37	31.56	26.37
				30.00	43.60	34.89	29.17
3	DDSL	Yes	Expensed	10.00	15.40	12.38	10.34
				12.00	16.22	13.03	10.90
				14.00	17.14	13.78	11.54
				16.00	18.11	14.52	12.14
				18.00	19.00	15.30	12.77
				20.00	20.11	16.12	13.50
				22.00	21.06	16.91	14.13
				24.00	22.15	17.77	14.85
				26.00	23.30	18.62	15.61
				30.00	25.63	20.54	17.13
4	DDSL	Yes	Expensed	10.00	20.56	16.55	13.82
				12.00	21.86	17.52	14.62
				14.00	23.33	18.73	15.63
				16.00	24.71	19.85	16.63
				18.00	26.18	21.00	17.54
				20.00	27.81	22.34	18.64
				22.00	29.30	23.50	19.64
				24.00	30.98	24.79	20.75
				26.00	32.61	22.24	21.85
				30.00	36.20	29.02	24.24

SYNOPSIS OF TEST CASE
650' EL DORADO SHALLOW, 650-ACRE
EL DORADO FIELD
Present Value Profile Results

TRIAL RUN	METHOD OF Depreciation SLD/SYOD/DOB/DBSL (1)/(2)/(3)/(4)	22Z STATUTORY Depletion Yes/No (1)/(2)	CHEMICALS Expensed/Capitalized (1) (2)	PRICE \$	RATE OF RETURN, %		
					207 BBLs/ac-ft	258 BBLs/ac-ft	310 BBLs/ac-ft
5	SLD	Yes	Expensed	11.90	5.00	8.68	14.91
6	SYOD	Yes	Expensed	11.90	1.16	8.65	15.03
7	DOB	Yes	Expensed	11.90	1.28	8.71	15.10
8	DBSL	Yes	Expensed	11.90	1.28	8.71	15.10
9	DBSL	Yes	Capitalized	11.90	0.0	0.54	5.53
10	DBSL	No	Expensed	11.90	0.0	2.20	8.29
11	DBSL	No	Capitalized	11.90	0.0	0.0	0.55
12	DBSL	No	Expensed	10.00	0.0	0.0	2.31
13	DBSL	No	Expensed	12.00	0.0	2.49	8.57
14	DBSL	No	Expensed	14.00	0.19	7.76	14.18
15	DBSL	No	Expensed	16.00	4.65	12.58	19.33
16	DBSL	No	Expensed	18.00	8.86	17.02	24.14
17	DBSL	No	Expensed	20.00	12.58	21.11	28.63
18	DBSL	No	Expensed	25.00	21.72	30.39	38.66
19	DBSL	Yes	Capitalized	10.00	0.0	0.0	0.66
20	DBSL	Yes	Capitalized	12.00	0.0	0.80	5.81
21	DBSL	Yes	Capitalized	14.00	0.0	4.98	10.42
22	DBSL	Yes	Capitalized	16.00	2.81	9.10	14.71
23	DBSL	Yes	Capitalized	18.00	6.06	12.85	18.85
24	DBSL	Yes	Capitalized	20.00	9.19	16.27	22.72
25	DBSL	Yes	Capitalized	25.00	16.36	24.23	31.44
26	DBSL	No	Capitalized	10.00	0.0	0.0	0.0
27	DBSL	No	Capitalized	12.00	0.0	0.0	0.08
28	DBSL	No	Capitalized	14.00	0.0	0.08	4.86
29	DBSL	No	Capitalized	16.00	0.0	3.78	8.90
30	DBSL	No	Capitalized	18.00	1.07	7.14	12.63
31	DBSL	No	Capitalized	20.00	3.88	10.09	16.02
32	DBSL	No	Capitalized	25.00	10.20	17.59	24.04
33	DBSL	Yes	Expensed	10.00	0.0	2.79	8.84
34	DBSL	Yes	Expensed	12.00	1.58	8.98	15.47
35	DBSL	Yes	Expensed	14.00	6.76	14.55	21.63
36	DBSL	Yes	Expensed	16.00	11.47	19.68	27.17
37	DBSL	Yes	Expensed	18.00	15.77	24.47	32.27
38	DBSL	Yes	Expensed	20.00	19.78	28.96	37.01
39	DBSL	Yes	Expensed	25.00	29.05	30.94	25.00